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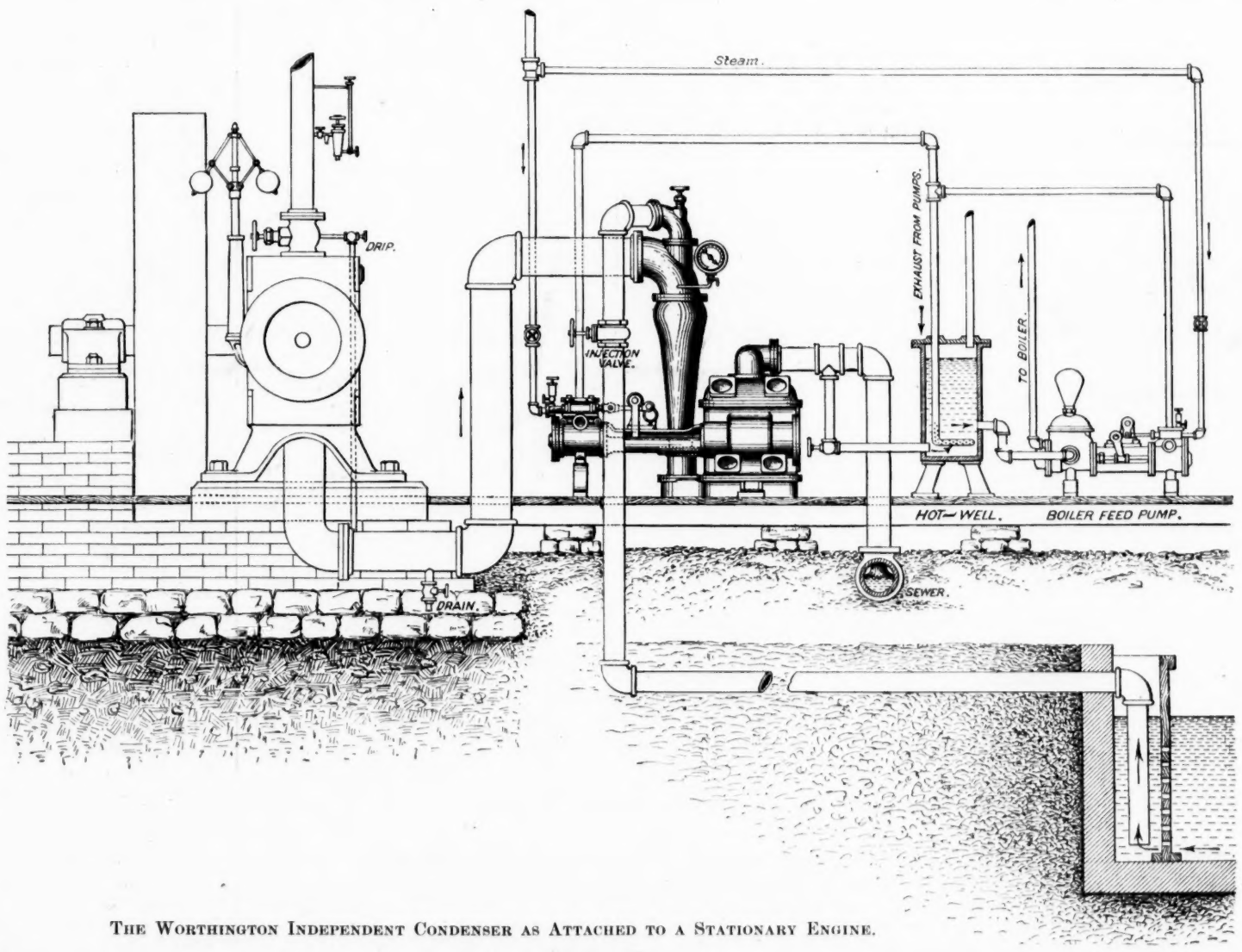
The Worthington Independent Condenser.

We illustrate on page 2 a sectional view of this condenser, and on this page one of its applications. Referring to the cut on this page, the exhaust steam is shown as passing directly from the engine to the condenser.

The injection water is lifted through the injection pipe from the water supply or source. A substantial strainer is placed around the lower end of the pipe, and is arranged so that the lower end of the pipe can be turned up and the strainer examined, or cleaned of foreign matter, if necessary. The injection water can be lifted vertically a distance of twenty feet (that is, 20 feet from the center of the injection opening to the surface of the water,) and horizontally any distance, provided the pipe is of ample size to flow the proper quantity of water without too great retardation by friction. When the injection pipe is over 75 feet long, a larger size pipe must be used than that called for by the tapped flange at the injection opening on the condenser. This pipe must be connected with care, and be tight. It should be laid with a slight inclination, so that the water will drain out when an air valve is opened at the upper end. This is done to guard against frost, when the apparatus is not in operation. A foot valve is only necessary with long lengths of pipe.



THE WORTHINGTON INDEPENDENT CONDENSER AS ATTACHED TO A STATIONARY ENGINE.

It is of no advantage to have the injection water supplied under a head or pressure. When the water is to be lifted, the pump will have to produce a vacuum of a degree corresponding to the lift, before the water will flow.

By the simple arrangement of piping shown, the discharge water is supplied to the hot well automatically. The water in the hot well is maintained at a level with the discharge pipe, by communication through the small pipe, the angle valve being left open. The exhaust steam from the condenser pump and the boiler-feed pump is conducted into the water in the hot well. The submerged pipe is perforated with small holes to subdivide the steam and to prevent noise. The exhaust steam is all condensed by the feed water, and returned together with all the heat contained in it to the boilers.

The sectional view of the condenser (page 2) shows plainly the general construction. Referring to this, *A* is the vapor opening, to which is connected the pipe that conducts to the apparatus the steam or vapor that is to be condensed, and in which a vacuum is to be made and maintained. The injection water used to produce the condensation of the steam or vapor is conveyed by a proper pipe attached to the injection opening at *B*. *C* is the spray pipe, and has, at its lower extremity, a number of vertical slits through which the water of injection passes, and becomes spread out into thin sheets. The spray cone *D*, by means of its serrated surface, breaks the water passing over it into fine spray, and thus ensures a rapid and thorough intermixture with the steam. This spray cone is adjustable by means of a stem passing through a stuffing-box at the top of the condenser, and is operated by the handle *E*. Any floating material that can pass an ordinary strainer will not lodge around this spray cone, but should it become obstructed from any cause, it can be washed clear by simply lowering the spray cone by means of the handle and stem. In order to lower the cone, the handle should be turned to "open," that is, in the direction opposite to the movement of the hands of a clock. When the foreign material has been carried away by the water, the cone may be returned to its proper position by turning the handle in the opposite direction as far, or nearly as far, as it will go. The cone should be left far enough down to allow the quantity of water needed for condensation to pass.

The pump is duplex, two steam cylinders and two water cylinders being placed side by side. It is of the well-known Worthington type of piston pump, built, however, with especial attention to the requirements of the service which is now being considered. The water cylinders are lined with composition, and the glands of the stuffing-boxes in the water-boxes are of the same material.

The operation of the condensing apparatus is as follows: Steam being admitted to the cylinders *K*, so as to set the pump in motion, a vacuum is formed in the condenser, the engine cylinder, the connecting exhaust pipe, and the injection pipe. This causes the injection water to enter through the injection pipe attached at *B*, and spray pipe *C*, into the condenser cone *F*. The main engine being then started, the exhaust steam enters through the exhaust pipe at *A*, and coming in contact with the cold water, is rapidly condensed. The velocity of the steam is communicated to the water, and the whole passes through the cone *F* into the pump *G* at a high velocity, carrying with it, in a thoroughly commingled condition, all the air or uncondensable vapor which enters the condenser with the steam. The mingled air and water is discharged by the pump through the valves and pipe at *J*, before sufficient time or space has been allowed for separation to occur.

It will be seen that the zone in which the condensation takes place is quite small, and the rapid effect is due only to the great surface exposed by the spraying water. In case the water accumulates in the condenser cone *F*, either by reason of an increased supply, or by a sluggishness, or even stoppage of the pump, as soon as the level of the water reaches the spray pipe and the spray becomes submerged, the surface is reduced to a minimum, only a small annular ring being exposed to the overpowering steam from the main engine. The vacuum is immediately broken, and the exhaust steam escapes by blowing through the injection pipe and through the valves of the pump, and out the discharge pipe at *J*, forcing the water ahead of it; consequently, flooding does not occur.

These condensers, which are applicable to all classes of engines, stationary or marine, are made by Henry R. Worthington, New York.

The Modern Steam Plant and its Management.

BY PETER H. BULLOCK.

BOILER FEEDERS AND APPLIANCES.

There are few boiler feeders more reliable than the simple plunger pump, driven by suitable connections with the main shaft of engine. There are plunger pumps set in gangs, and driven by gearing and cone pulleys, that are very regular boiler feeders, and are simple and convenient to operate. At slow speeds, the suction of plunger pumps may be partly closed, and the supply regulated by that means, but at a quick stroke the

jar becomes unpleasant, if not dangerous to the pipe and fittings. The writer is familiar with a plant where the tank is in the basement of an engine room, where it receives drips and returns from numerous dry rooms, and in which the water often becomes so hot that it cannot be drafted by the pumps five feet above it. It was desired to pump this water directly into the boilers, and the following rig was erected. A plunger pump was set one foot below the bottom of the tank, and a valve put into the pipe that connected them. An inch and a quarter hole was drilled into the end of the 12-inch crank shaft, and a steel pin put in, having a stroke of 10." A connecting rod is run horizontally from this to one end of a bell crank, six feet distant, the other end being over and connected by another rod, directly to the pump below. This made a positive motion for the pump, but there was no means of changing the stroke or speed. It worked nicely, and would just supply the required amount of water when all the work was on, but there were times when less steam was being used, and the pump then gave too much water. If the valve in the suction pipe was partly closed, so that the cylinder would not quite fill, there would be a violent shock and jar to all the pipes when the descending plunger struck the water. The following proved a complete remedy: a half-inch pipe thread was tapped into the cylinder near the bottom, and a common check valve screwed in, opening inwardly. A pipe was brought from that up to the top of the floor, and an air valve put on. Now you could partly close the suction, and by opening the air valve a little there would be enough air enter the water cylinder for the plunger to cushion on, thus entirely avoiding the jar. This, of course, put a little air into the boiler at each stroke, but in this case it did no harm, as the engine was not condensing. It was found that this air could be "bled" out of the air chamber by a very small pet cock; also that steam from the exhaust pipe would do just as well as air, provided the water was very hot; but if it was not, then the steam would condense and the jar would be worse than without it.

For actual power consumed in forcing water into a boiler, there is no form of apparatus that can compete with a power-driven plunger pump, unless it be the exhaust injector, which, under some circumstances, is an excellent thing to have and use, but under different conditions it may be positively dangerous. This instrument will do exactly what its inventors claim for it, but it will not do all that some others have claimed it would. Supplied with exhaust steam, clear of water, at one pound pressure, it will lift water at 110° a very short distance, and force it into a boiler against a pressure of from forty to sixty pounds, according to the condition of the delivery pipe. This always depends upon its length, size, number of turns and internal condition. I have seen one working against eighty pounds, but the conditions were exceptional. The pipe was brass, short, ample in size, with few turns, and those of bent pipe. If the oil used in the cylinder is a pure mineral, and small in amount, there need be no fear of trouble from that source; but if animal oil is used, and a good deal of it, or if the water is hot in the tank, or the pressure too high, or the pipes in poor condition, don't try an exhaust injector; for, if you do, you will either have trouble from oil in the boiler or in keeping the injector working.

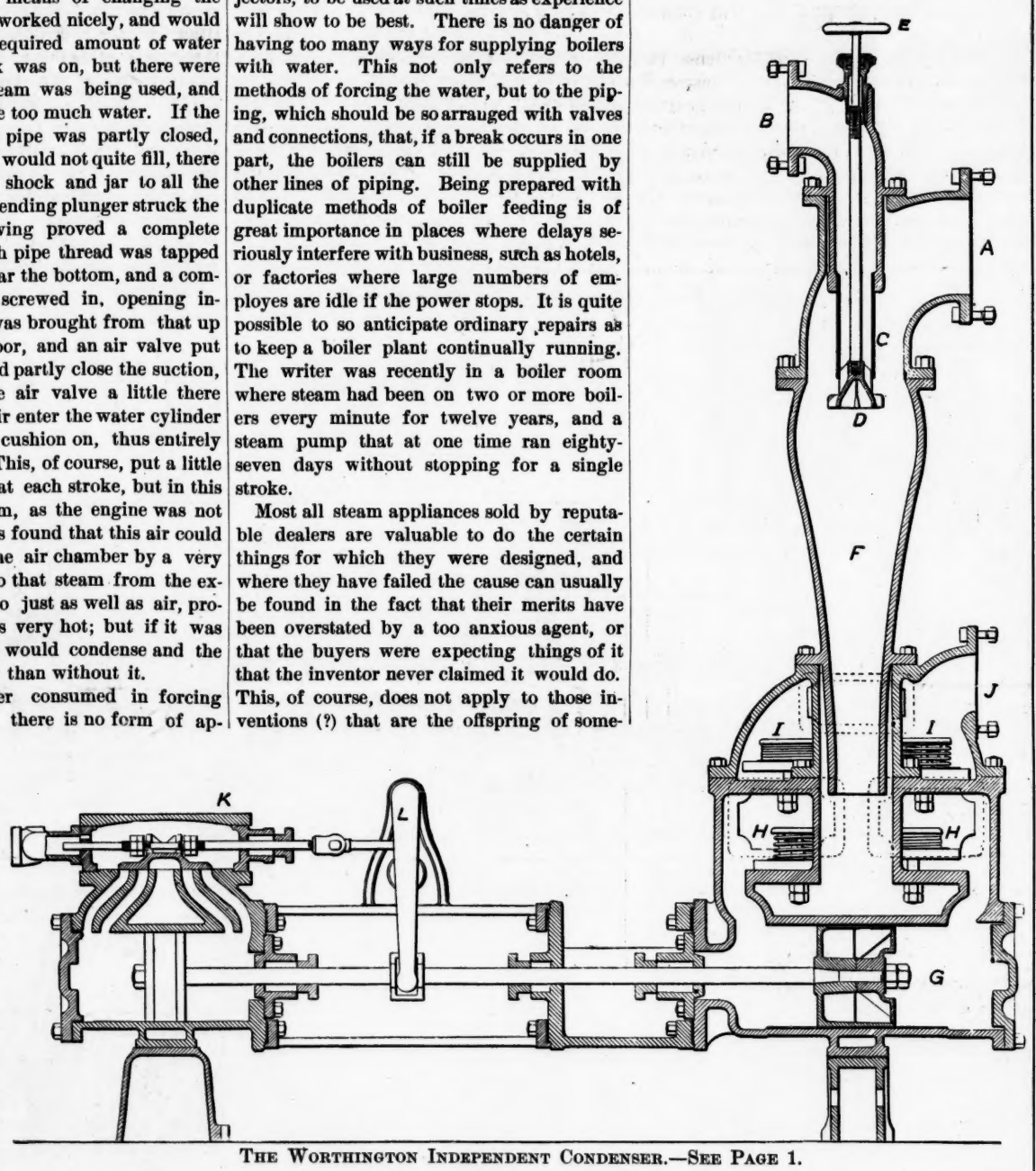
There are numerous direct steam injectors, most all of which are reliable if used under the conditions for which they are intended. There are those of the inspirator class, that will lift water as far by suction as the average pump, and then force it against any pressure the boiler may carry, and they will use steam in proportion to the work they do. There are others that are non-lifters, and will only work if the water flows to them. Others will take comparatively hot water; but, as all are operated on the principle of the condensation of the steam that has imparted its velocity, *i. e.*, force, to the water that has condensed it, the colder that water is the better the injector will work.

There is a field for all the different methods of boiler feeding, and their selection should be governed by the conditions that exist in the place they are to be used. Where it is possible to secure all the useful appliances, and where there is a good deal of hot water, it is economy to use a low set plunger pump for the purpose, and this should be supplemented by one or more steam pumps and injectors, to be used at such times as experience will show to be best. There is no danger of having too many ways for supplying boilers with water. This not only refers to the methods of forcing the water, but to the piping, which should be so arranged with valves and connections, that, if a break occurs in one part, the boilers can still be supplied by other lines of piping. Being prepared with duplicate methods of boiler feeding is of great importance in places where delays seriously interfere with business, such as hotels, or factories where large numbers of employes are idle if the power stops. It is quite possible to so anticipate ordinary repairs as to keep a boiler plant continually running. The writer was recently in a boiler room where steam had been on two or more boilers every minute for twelve years, and a steam pump that at one time ran eighty-seven days without stopping for a single stroke.

Most all steam appliances sold by reputable dealers are valuable to do the certain things for which they were designed, and where they have failed the cause can usually be found in the fact that their merits have been overstated by a too anxious agent, or that the buyers were expecting things of it that the inventor never claimed it would do. This, of course, does not apply to those inventions (?) that are the offspring of somebody's hobby, but to appliances that are intended to do certain things that experience has proved to be necessary to be done, and which work under conditions to be found in every-day practice, such, for instance, as damper regulators, and valves for reducing steam pressures. The other kind of appliances is of the sort that would perhaps accomplish some things if the conditions actually existed to bring these things about; or, in other words, the conditions would have to be prepared or presupposed in order to make the appliance even useful. If the claims of these inventors were founded on facts, the running of a large steam plant would be a source of profit from the great savings that could be made by the use of their appliances; for it is indeed a modest inventor that will not claim to be able to save at least 50% by the use of his revolving smoke arch, and as much more by a few injections of his cathartic boiler purges. The more unreasonable the claims, the quicker some will jump at the bait.

In the eastern part of Massachusetts there is a small factory, the proprietor of which is always on the lookout for something that is going to revolutionize the old way of doing things. It was five years before his long-suffering engineer could get him to procure a sight feed oil cup, but during that time he had tried an apparatus to pump the exhaust back into the boiler, an arrangement for "lassooing" the governor if the engine run away, and been duped by a sharper who proposed to get gold out of common furnace clinkers. They were troubled for want of draft, and had contemplated putting twenty feet more on to the chimney. One day the proprietor appeared in the engine room with a distinguished looking gentleman who was talking fluently about the universal law of spirality in nature. He told of the twisting vines, the eddies of rivers, and the mighty whirlpools of the ocean; but solids and liquids, said he, are slow in comparison to gases; as, for instance, the whirlwinds and cyclones that level the greatest works of man, and uproot the virgin forest. "Man," said the inventor, "must imitate nature if he wants to produce a great force; therefore, if you want a tornado roaring up your chimney you must give the gases a twist at the base by using one of Professor Suckem's Patent Spiralators." This proved to be an immense sheet-iron corkscrew arrangement, to be introduced in sections into the bottom of the chimney, and would have the same effect, the inventor said, as changing a smooth-bore gun to a rifle, and that there would be a revolving tunnel-shaped cloud of smoke surmounting the chimney at all times when there was a fire under the boiler. It was put in, and on the first day's trial, owing to a good wind, there was a pretty good draft, but the ornamental feature of the cyclodomic cloud was wholly wanting; in fact, it never did materialize during the short time the "spiralator" encumbered the flue.

A common-sense man would have reasoned thus: There is not draft enough in my chimney; will it be improved by putting an obstruction in it? The result of such reasoning would be that no time nor money would be fooled away by such nonsense. Apply this rule to all alleged inventions, and if they won't stand your common-sense inquiries reject them at once as something you do not need.



THE WORTHINGTON INDEPENDENT CONDENSER.—SEE PAGE 1.

Design, Construction, Repairs and Management of Marine Steam Engines and Boilers.

BY W. H. HOFFMAN.

TWENTY-FOURTH PAPER.

I have shown that, by using a bed plate composed of cast-iron, wrought-iron and wrought-steel, we can obtain the maximum strength and minimum weight, and also that, by making the cast-iron uprights of the proper form, they, too, can be greatly reduced in weight.

The reciprocating and running gears of our engines are light, for we have high piston and rotative speed, and balanced valves to assist us. The steam cylinders are small, because of the high piston speed, which is 756 feet per minute at its maximum, and this system has been adopted by all the best builders, after exhaustive experiments in this direction.

The only trouble found with high rotative speeds for large condensing engines, is in the working of the air pump or pumps, when they are directly connected to, and move in unison with the reciprocating parts of the main engine. The writer has yet to see an efficient air pump making more than 80 revolutions, or 160 beats per minute, and I think that this statement has been verified by the results obtained on the new Inman steamship, the City of New York. I have been told by gentlemen who have seen these engines under their highest rotative speed—from 80 to 86 revolutions per minute—that with the air pumps disconnected from the main engines, and operated by independent means, these 5-feet stroke engines would make 90 revolutions without any trouble, but as they are now arranged, they considered 75 revolutions to be the safest speed for continuous running.

The efficiency of an air-exhausting pump for any purpose depends on the economy in clearance, the length of stroke, the position of the barrel and valve chambers, and, most important of all, the time allowed for the valves to seat themselves. A short-stroke air pump is not efficient, because the clearance is more in proportion to the whole stroke and piston speed than the clearance of a long-stroke pump. I am, of course, now speaking of engines developing from 350 to 3,500 horse-power. In smaller powers, the writer has succeeded in running a long-stroke air pump at very high piston and rotative speeds. In three instances these pumps were $4\frac{3}{8}$ inches in diameter, with a stroke of 16 inches, attached directly to the cross head of a vertical tandem compound engine; cylinders 12—21 x 16 inches, and running at 230 revolutions per minute. These pumps maintained an average vacuum in continuous running of 24 inches, and would frequently show 26 inches. The foot valve clearance was $3\frac{1}{2}$ per cent., and the lift of all of the valves $\frac{3}{16}$ inch; the diameter of these valves being 2 inches, and the materials used brass and rubber combined. The valve area was large compared with the volume of water and air moved, and it was thought that the proportions used would enable us to maintain a vacuum of 26 inches at a speed of 280 revolutions per minute, but at that speed the pointer would register only a little above 20 inches. All other conditions were the same as when running at 230 revolutions per minute.

I have cited these practical illustrations in order to show that, with a certain class of small marine engines, an air pump directly attached can be made to produce very fair results, but for commercial service I cannot recommend this system, when high rotative speed is adopted for propulsion. Then, again, I cannot endorse the design so common at present, where the surface condenser shell is a part of the engine upright frames. This may present a compact arrangement, but it is not a scientific one. It is impossible to keep

the bore of the cylinders in perfect alignment with the guides when one side of the engine frames is many degrees warmer than the opposite side. The lengthening variations by actual measurement may not be great, but it is quite enough to cause an undue frictional resistance on the pistons and crossheads.

In our design, the surface condenser will be entirely independent as to its structural arrangements. The shell will be similar in form to those now used, but it will be made of brass, tinned, instead of iron, the former material being far superior for salt water service. The shell of the surface condenser will have lugs or brackets on its lower side, that will rest on the extended portions of the engine keelsons, while on the top side of the shell there will be flanges cast with adjusting slots, to receive bolts that will screw into the engine uprights. The condenser shell will be in four pieces, divided and flanged together in both vertical and horizontal directions, thus presenting a simple form of casting. The body of the condenser shell will be $\frac{1}{2}$ inch thick, and ribbed on the outside in squares of 16 inches, these ribs being $\frac{7}{16}$ inch thick, and $3\frac{1}{2}$ inches deep. The tube and outside heads will be held in position by swinging bolts, made of Muntz metal, fitted with nuts of the same material. The upper and lower sides of the shell will be semi-circular in form, and the ribs will be reduced in depth to $1\frac{1}{2}$ inch at the crown of the curves.

The condenser tubes will be seamless, each $\frac{3}{4}$ inch diameter, and 9 feet 4 inches long, the metal containing at least 68 per cent. of copper. The tubes will be pitched $1\frac{5}{16}$ inch from center to center, thus giving us 123 tubes to the square foot. Each tube should condense from 20 to 24 lbs. steam per hour, and, as we shall pass through about 42,000 to 46,000 lbs. of steam per hour, we will find that, with a terminal pressure of 8 lbs. per square inch, 1.70 square feet of cooling surface will be ample, say 5,600 square feet total, and this will call for 3,500 tubes. This number of tubes will require about 27 square feet of cross-section, and, to allow space between the tubes and the shell for the exhaust steam, we must make the shell 3 feet 9 inches wide, and 8 feet 6 inches high in the clear.

If the terminal pressure is never to be above 8 lbs., 4,800 square feet of cooling surface would be enough; but in heavy weather and fast running the terminal is liable to range from 8 to 14 lbs., therefore we must have a margin of condensing surface.

As for the packing of tubes, I believe in the screwed stuffing-box, fitted with the best fibrous packing. For packing, the compressed asbestos thimbles have given general satisfaction, although paper, wood and rubber are extensively used.

On the top of the condenser shell, and immediately in connection with the main and other exhaust pipes going to the condenser, will be a suitable grease extractor, that will remove the cylinder oils, and thus prevent their passage to the condenser and boilers. As we increase the number of cylinders and valve chests, we necessarily increase to a certain extent the quantity of cylinder oil; therefore the collection of "oil patches" in the condenser, and on the inside surfaces of the boilers, will be correspondingly increased, if we do not use some special device to remove or prevent them.

A thorough consideration of the points enumerated above will satisfy those interested, that a brass condenser shell, tin-coated, will be the most economical in every way, although the expense at first may be considerably more than the cast-iron shell. The brass shell gives increased strength and absolute safety from breakage, and this item alone is of enough importance to insure its general adoption for sea-going steamers.

The largest railway station in the world is the one at Frankfort-on-the-Main. It covers a superficies of 335,916 square feet. Hitherto, the largest stations have been the Saint Pancras at London (166,625 square feet) and the Silesia station at Berlin (130,000 square feet). That of Frankfort is double the size of the first named.—*La Semaine des Constructeurs.*

The Equalization of Lead and Cut-off in Slide Valve Engines.

BY FREDERIC A. HALSEY.

FIRST PAPER.

The purpose of this and the following papers is threefold. First, to describe the existing valve motion of the Straight Line engine; second, to describe a new method of laying out the same mechanism, so as to produce different results; and third, to describe still another method of laying out the same mechanism, so as to obtain at once the results of both the first and the second constructions.

The lead of a valve may vary in two ways, and to prevent ambiguity it is necessary to define and follow an exact use of terms. The reader is asked to note carefully the following explanations of the terms equal lead and constant lead. They will be used, strictly as defined, throughout these papers, and it is necessary that they be clearly understood.

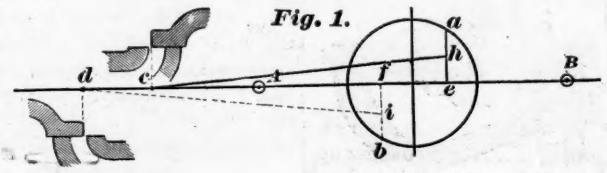
Equal lead implies that the lead is alike at the two ends of the cylinder. Constant lead implies that the lead does not change for different grades of expansion. An engine might have equal lead for one grade of expansion, and unequal lead for another grade, or the lead might be equal at each grade without being constant; that is, the lead might be always alike at the two ends of the cylinder, but larger at both ends for three-quarters cut-off than for one-quarter. So, also, an engine might have constant lead without equal lead; that is, the lead might not change for different grades of expansion, but at the same time be always larger for one end of the cylinder than for the other.

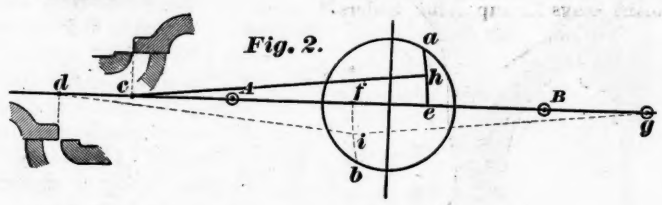
The above distinctions are radical and important, and it is necessary that they be clearly seen in order to understand what follows.

The standard books on the slide valve, when treating of engines with fixed cut-off, explain a method of equalizing the cut-off at the expense of equality of lead; but as equality of lead is of more importance than equality of cut-off, the method is seldom adopted, and it has come to be generally accepted, that the lead or the cut-off must be unequal. It has also been generally accepted that, in engines with shifting eccentric (single valve automatics) the lead cannot be constant, but must change as the grade of expansion changes, and can only be equal at some one selected grade of expansion.

It will be shown, in what follows, that neither of these assumptions is correct.

The manner in which the angular vibration of the connecting rod produces inequality in the cut-off, whether the eccentric be fixed or not, is well understood, and need not be rehearsed here; but the action which prevents the lead from being constant in engines with shifting eccentric is not so well understood, and will bear explanation. In all of the diagrams, the cylinder is supposed to be on the left of the shaft, and the engine is supposed to run "over." The throw of the eccentric is made disproportionately large, and the eccentric rods disproportionately short, to add to the clearness of the constructions without unnecessarily large diagrams. This gives the appearance of a distorted valve movement; but with working proportions these apparent distortions are no greater than with the usual construction, and are not objectionable. This feature of the diagrams also shows a greater irregularity in the lead in the usual form of construction, as well as in the form to be described, than actually obtains with working proportions. This, however, for the present purpose, is rather an advantage than otherwise.





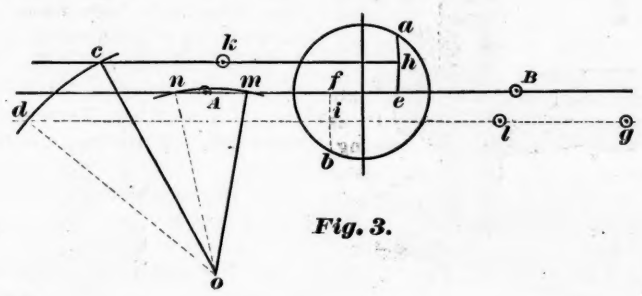


Fig. 3.

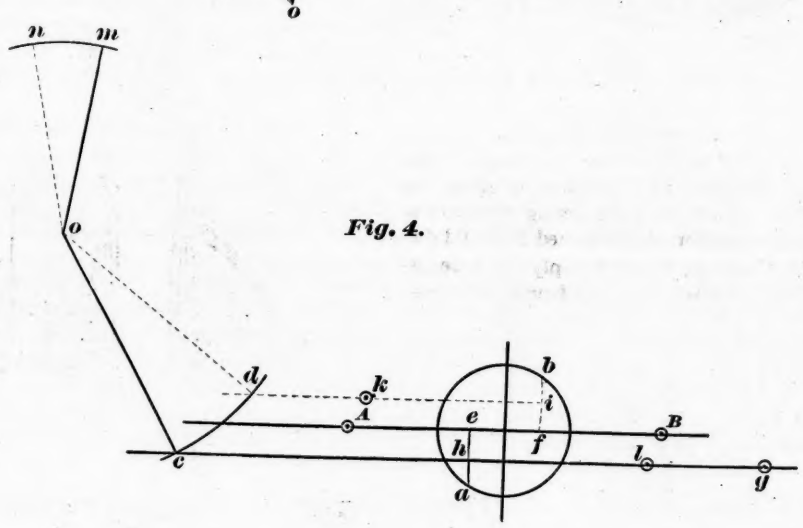


Fig. 4.

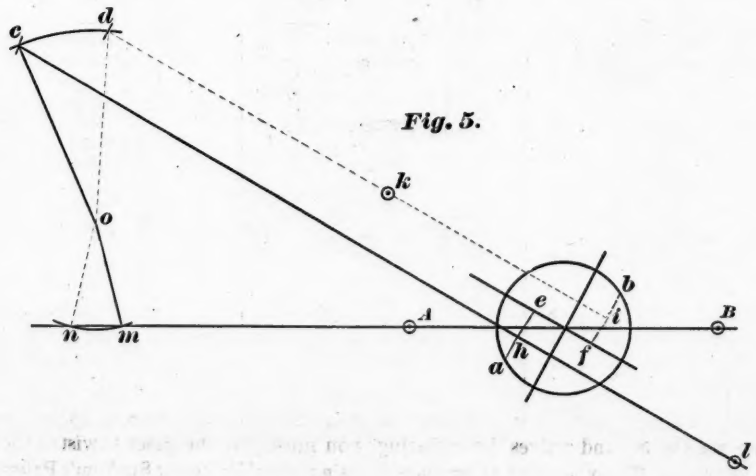


Fig. 5.

In Fig. 1 let A, B represent the crank-pin of a shifting eccentric engine when on the dead centers, a, b being the corresponding positions of the eccentric center at its greatest throw, h, i at its mean throw, and e, f at its smallest throw. The positions of the eccentric rod for mean throw of the eccentric are shown at c h, d i, and the valve in both positions is open by the amount of its lead, as shown by the upper valve sketch for c, and the lower one for d. Let the path of the eccentric center, when shifted across the shaft to change the expansion, be a straight line occupying the position a e for crank position A, and b f for crank position B. Imagine the crank on the center A, and shift the eccentric toward e. Obviously point c will be moved to the left, and the lead will be disturbed. For crank position B, the same is true, and what is still worse, while the movement for crank position A decreases the lead, that for B increases it. If, with crank at A, the eccentric be shifted toward a, and with crank at B toward b, the lead at the two points will be disturbed in the opposite directions; *i. e*, for position A the lead will be increased, and for B decreased. The broad fact is evident, that an engine laid out as shown in Fig. 1 could not have a constant lead, and it could only have an equal lead for some one (selected) grade of expansion. Instead of shifting the eccentric, as shown in Fig. 1, suppose a large disk keyed to the shaft, and arrange the eccentric to swing about a pin fixed to the disk, the center of the pin for crank position A coinciding with c, Fig. 2, thus changing the straight line a e of Fig. 1 to the arc of a circle. Now, shift the eccentric from h toward e or a, and c will not be disturbed. When, however, the crank is at B, the pin c will be at g, and if the eccentric be shifted from i toward f or b, point d will obviously be disturbed more than in the corresponding movement of Fig. 1, and it may be said in general, that, with the eccentric rod arranged in the common way, as shown in Figs. 1 and 2, any change in the path of the eccentric across the shaft, to correct the inconstant lead at one dead center, will only make matters worse at the other, and by no possible modification can the lead be made equal for more than one grade of expansion.

The subject of correcting these inequalities will now be taken up, under the following heads:

I. Obtaining a practically constant and equal lead at all grades of expansion.

II. Obtaining an exactly equal cut-off in engines with fixed eccentric, without disturbing the equality of the lead.

III. Obtaining a practically constant and equal lead, and a practically equal cut-off, in shifting eccentric engines, by a method which at once fulfills the conditions of I and II.

Method I is the work of Professor Sweet. Method II was devised by the writer, but since this paper was commenced, it appears that Professor Sweet also invented it some years ago. Method III the writer believes to be his own, and new. It should, however, be explained here, that the Straight Line engine is not now built in strict accordance with Method I, a later improvement being the introduction of an equal, but inconstant lead; that is, the lead is always alike at the two dead centers, but it is less for short cut-offs than for long, and in the earliest cuts is

negative. This result of inconstant with equal lead is just as impossible of attainment with the methods of Figs. 1 and 2, as is constant with equal lead, and its object and method of attainment will be explained in the proper place.

All of the constructions require the use of a rock shaft in the valve motion, and as there are two types of rock shaft, so there are two cases for consideration. In the first type of rocker, the eccentric and valve rods engage it on the same side of the fulcrum (as exemplified in the rocker for the main valve of the Buckeye engine). In the second type, the two rods engage it on opposite sides (as exemplified in the rocker used in all American locomotives). In the Straight Line engine as actually built, the second type of rocker is always used, for reasons which will be explained, but both types will be considered here.

I. Obtaining a practically constant and equal lead at all grades of expansion.

In Fig. 3, the parts are lettered as in the previous figures. From *h* and *i*, *h c* and *i d* are drawn parallel to the center line, and each is made equal to the length of the eccentric rod. The rocker fulcrum is then so located at *o*, that the pin for the eccentric rod shall describe an arc passing through *c* and *d*. The pin for the valve rod is located as usual, *m* belonging with *c*, and *n* with *d*. The eccentric is shifted by being swung from a pin, whose location for crank position *A* coincides with *c*. As explained in connection with Fig. 2, the disturbance of the lead for crank position *A* is thus eliminated. When the crank is at *B*, *c* is at *g* in line with *i d*. In this position of the parts, shifting the eccentric on the line *b f* will disturb the lead a trifle, though much less than in the primitive constructions of Fig. 1 or 2. We have here, then, a construction, which eliminates the disturbance for crank position *A*, and practically eliminates it for *B*. It is thus radically unlike the construction of Fig. 2, which improved matters at *A*, but only to make them still worse at *B*. Comparing Figs. 2 and 3, the essential difference in the two plans is apparent. In Fig. 3 *c h* and *d i* are parallel and hence both *c* and *g* are in line with the eccentric rod position to which each belongs, whereas in Fig. 2 *c h* and *d i* are not parallel, and hence, while *c* is in line, *g* is not, and cannot be made so. The construction so far explained, would, however, lead to inconvenient dimensions of some of the parts. The center of motion for shifting the eccentric is therefore in practice moved inward from *c* to some convenient point *k*, on the line *c h*, the eccentric rod pin still remaining at *c*. The position of *k* for crank at *B*, is of course *l*. This change introduces a trifling error for crank position *A*, and by an equal amount increases the existing error for *B*, but the final irregularity is infinitesimal as compared with Fig. 1 or 2, and the mechanism accomplishes its object—"obtaining a practically constant and equal lead at all grades of expansion."

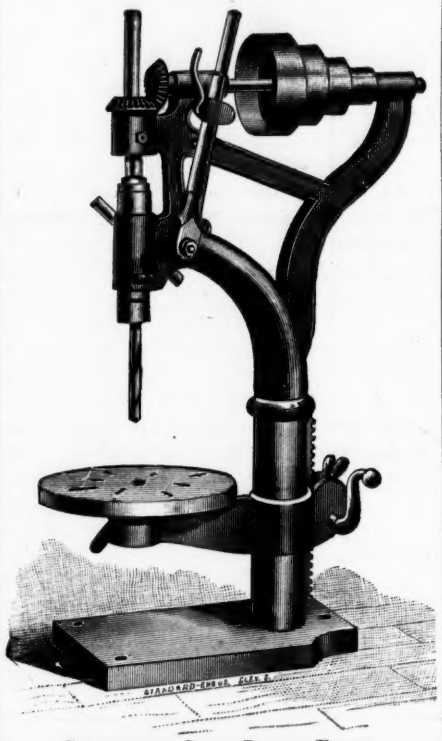
The second type of rocker introduces no material change in the lay out. For an engine with the steam chest on top of the cylinder, it is illustrated in Fig. 4, the parts being lettered to correspond with Fig. 3. This type of rocker reverses the motion of the eccentric, and hence positions *a*, *b* change places as shown.

As the Straight Line engine is actually built, however, the steam chest is on the side of the cylinder, and hence the second type of rocker takes the unusual form of Fig. 5. There is, however, no change in the essential principle of the construction, which is, that the two positions of the eccentric rods which belong with crank positions *A*, *B* shall be parallel to one another. The object of using this form of rocker is as follows: This valve motion, like the usual form, when set for equal lead, gives a larger port opening for one end of the cylinder than for the other.

It is well known that the speed of the piston is faster in the end of the cylinder farthest from the crank-shaft. Now the second type of the rocker gives the large port opening to that end of the cylinder in which the piston travels the faster, while the first form gives the reverse relation. Hence the choice in the construction.

Seventeen-Inch Drill Press.

The illustration shows a drill press made by William W. Brisben & Co., Cleveland, Ohio. The design is sufficiently well shown by the engraving, it being necessary to say only that the column is 4″ diameter, table 14″, vertical travel 18″, spindle is $1\frac{1}{16}$″ diameter of steel, with hole for No. 2 Morse taper. There is a lever feed, and a spindle travel of 6″. Cone pulleys are for a 2″ belt, and the tight and loose pulleys on counter for $2\frac{1}{4}$″ belt. Speed of counter, 230 revolutions.



SEVENTEEN-INCH DRILL PRESS.

Shop Time Keeping.

At the shops of Watson & Stillman, New York City, they have recently devised and put in practice a system of time keeping which has many advantages over any other system with which we are acquainted.

Each job done in the shop has a designating number by which it is known. Each man employed also has a number assigned to him, by which he is known and designated upon the books and the time cards. Then the time keeper and each foreman having authority to give out or to accept finished work from the workmen, has a number, and carries a punch (similar to those used by conductors), which punches his number. Fig. 1 shows a blank time slip, which is dated for the day on which it is to be used, by stamping in the blank space left for that purpose below the word "Laborer," as shown in Figs. 2 and 3.

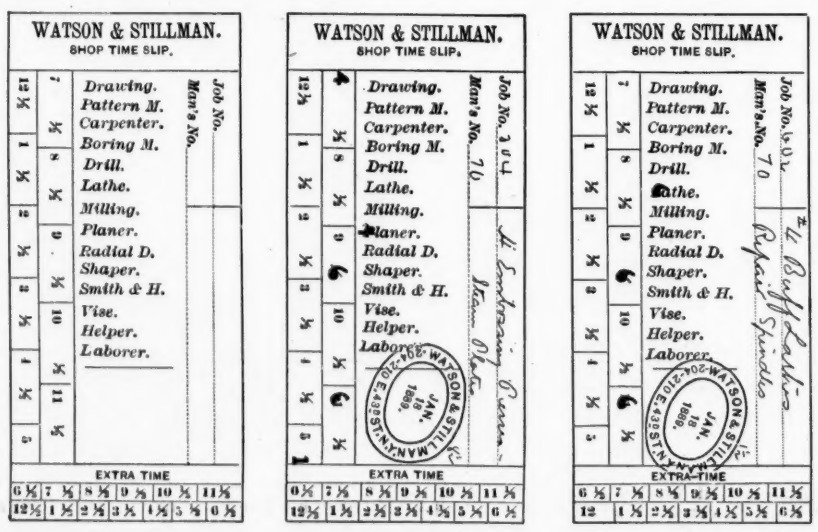


FIG. 1. FIG. 2. FIG. 3.

SHOP TIME KEEPING.

Supposing foreman No. 4 gives to workman No. 70 planer work to do on job No. 304 at 7 o'clock on the morning of Jan. 18, 1889. Foreman No. 4 gives to workman No. 70 a slip stamped with the proper date, as shown at Fig. 2, the blank spaces along the right-hand edge of which he, at the same time, fills out with pencil, as shown, and with his punch (No. 4) he punches the word Planer, as shown, and the figure 7.

This card then shows that man No. 70 commenced a job of planer work on job No. 304 at 7 A. M. of the given date, under the direction of foreman No. 4.

At 9.30 foreman No. 6 (superior to No. 4) stops the planer and puts the man onto a lathe job wanted in a hurry. With his punch he punches 9.30 on the man's slip, and at the same time gives him another slip filled out and punched as shown at Fig. 3, except that the figure 11 is not yet punched out. At 11 A. M. the man (70) reports this job finished and goes back onto the planer job, when foreman No. 6 punches both slips at the figure 11, as shown. At quitting time the time keeper takes up both cards, punches the slip, Fig. 2, with his punch No 1, to show that the man was working upon that card at quitting time, and marks upon each card the amount of time shown by the punch marks; assorting them afterwards and making the proper entries on a time sheet representing the entire job, after which he files them away.

Regarding the plan Mr. Stillman says: "By this record, easily and quickly made, we have a record which cannot be changed, and prevents having a customer say that time must have been taken up wrong by time keeper, or given wrong by man, for

1st. The foreman certifies that the man was at work under his (No. 4) instruction (unless at 7 A. M., when, if previously at work on same job, any foreman punches beginning hour).

2d. He was taken off by No. 6 under special instruction, and job was *accepted* by No. 6 at 11 o'clock as finished.

3d. The man's time is beyond mistake, or, if he thinks too much time has been spent on a small job, "under reporting," and giving balance on some larger job on which he is working, is prevented.

4th. Bookkeeping is reduced to a minimum.

5th. At any time we can tell in a few minutes who did the work, and under whose instruction.

6th. The slips may be re-sorted from job into parts of job, and time spent on a part known to a certainty. In fact, a complete *certified* record of time is always at hand if question arises regarding time.

The record made on this, of changing from a planer to lathe, is not one usual in our shop, but is here assumed to show its flexibility and accuracy. On the extra time end the foreman certifies to time of stopping work, leaving to the office time keeper to adjust rates of increase."

A system of filing drawings in use in these shops is also worthy of notice. They are kept in cabinets having shallow drawers, upon the outside of which the class of machines to which the drawings relate is indicated. The drawings or tracings for a single machine, though they may be in a drawer with the drawings of other similar machines, are kept separate from them by simply folding about them a large sheet of manila paper, which covers all the drawings for a given machine, in the same manner as the cover of a book, except that it is not fastened to them in any way. The sheets of manila paper, when folded, are just large enough to fill the drawers, and yet go in and can be taken out easily. On the upper right-hand corner of these covers, and next the front of the drawers, is written the number or symbol of the machine, and also its name in full. The drawings of any given class of machines being in contiguous drawers, and the cover of those which are of a given machine being plainly marked, it is the work of but a moment to find the drawings for a given machine, and when found they can be taken from the drawer and replaced with the greatest ease, since by simply drawing out the designated manila paper cover, and opening it, all the drawings relating to the given machine are at hand. The system is elastic, the number of drawers devoted to any one class of drawings being easily extended or diminished at any time, the number of drawings in a single drawer devoted to one or more machines being also variable either way, without the least disarrangement or interference with the system. Finally, it is applicable to any system of symbols for machines and drawings, or to any construction or style of drawers. It also saves much wear and tear of drawings, since in taking them from the drawers, or looking them over, only the manila covers are handled or shoved over each other—never the drawings themselves.

A Case of Sharp Practice.

First in order we give the subjoined letter:

AMERICAN MACHINIST, 96 Fulton street, New York, N. Y.

GENTLEMEN: As perhaps you have noticed, there seems recently in England to have been a marked increase in the extent to which American tools are reproduced, and we have been considerably annoyed by reproductions of our machines, and copies of our cuts and illustrations. Perhaps the most complete case of this kind is the catalogue of John Holroyd & Co., "Limited," which we hand you enclosed herewith. This catalogue, as you will note, is largely made up of reprints from our catalogue, those of the Pratt & Whitney Co., and the Morse Twist Drill and Machine Co. It has seemed to us that the mechanical papers on both sides of the water should condemn such practices, and we united with the Pratt & Whitney Co., and the Morse Twist Drill and Machine Co., in writing a letter for publication in England, and sent it to our agents, Messrs. Buck & Hickman, of London, who tell us that they have tried in all quarters to get this letter, or some modification of it inserted, but without success. Yours truly,

BROWN & SHARPE MFG. CO.

It appears to us to be best to give the letter referred to above, substantially as it was refused publication in England. Doing so will give our readers better opportunity to judge of the merits of the case than any mere reference to it can do.

THE SUBSTANCE OF THE COMMUNICATION OFFERED ENGLISH JOURNALS.

DEAR SIR:

Our attention has been called to a catalogue issued January 1, 1888, by John Holroyd & Co., Lim., machinists, engineers and tool makers, Hulme, Manchester, and on examination we find it is largely devoted to illustrating and describing copies of machines and tools, which were designed, and are now being made in the United States.

Quite a number—46 out of the 126 pages—are practically reprints from the 1887 catalogues of the undersigned. Pages 6, 7, 17, 19, 20, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71 and 101, are, in many respects, identical with pages in the catalogue of the Brown & Sharpe Mfg. Co., Providence, R. I., and represent copies of the "No. 1 Universal Milling Machine," screw slotting machine, screw slotting device, patent milling cutters of irregular form, milling cutters, side milling cutters, patent cutters for grooving taps and reamers, patent cutters for making twist drills, emery wheel arbors, metal slitting saws, screw slotting cutters, screw slotting cutter arbors, angular cutters, cutters for spiral mills, cutters for the teeth of gear wheels (which can be sharpened by grinding without changing their form), involute and epicycloidal, and vises for use upon milling and planing machines.

Pages 10, 11, 12, 14, 15, 16, 18, 38, 40, 41, 51, 52, 54, 55 and 57, are in many respects reproductions of the catalogue of the Pratt & Whitney Co., Hartford, Conn., and represent copies of Lincoln pattern milling machine, "No. 1 Hand Milling Machine," "No. 2 Hand Milling Machine," "No. 1 Wire Feed Screw Machine," "No. 4 Screw Machine," screw cutting engine lathe, grinding lathe,

Slate patent taper attachment for engine lathes, hand screw press, horizontal tapping machine, vertical tapping machine, hand wheel rim turning machine, marking machine and cutter grinder.

Pages 56, 80, 81, 82, 83, 84, 85, 86, 87, 88, 90, 91, 92 and 93, are taken with more or less completeness from the catalogue of the Morse Twist Drill and Machine Co., of New Bedford, Mass., and represent copies of the twist drill grinding machine, straight lip twist drill with grinding line, straight shank drills, drills to Stubbs' steel wire gauge, straight fluted drills, straight shank machine bits for wood, drill gauge from $\frac{1}{16}$ inch to $\frac{1}{2}$ inch, twist drill and steel wire gauge, Beach patent drill chuck, Stetson's patent improved Beach drill chuck, socket with rough shank and plug, socket with finished shank and shell sockets.

Several pages appear to be illustrations of the sensitive drill made by Dwight Slate Machine Co., Hartford, Conn.

In most of the pages above referred to, the cuts are identical with those in our catalogues, and the descriptions in many cases are copied almost verbatim. Our names, however, and patent dates are conspicuously absent. Speaking for our own tools, the conduct of John Holroyd & Co., Lim., has been entirely without leave or license. We never authorized them to use our designs, nor have we ever been offered any remuneration for their use. We have never heard of any credit having been given us for them, either publicly or privately. On the contrary, in their catalogue John Holroyd & Co. state that they "have specially designed these tools" (which are American throughout, and which we invented for use on an American market,) "to combine the best features of English and American labor-saving appliances."

Such a wholesale performance as this, we think, would not be tolerated in the United States. The practice of unauthorized copying is not here countenanced by first-class establishments. It at once causes loss of standing among manufacturers, neither is it favored by purchasers. To reproduce without permission, even though there be acknowledgment of copying, is not considered creditable. To copy and even tacitly to claim originality is considered contemptible.

At present this does not seem to be the case in England. Public opinion with you on this point seems inert. We have confidence, however, that, as the facts become known, public opinion will find emphatic expression. Plagiarism, literary or mechanical, when discovered is seldom uncondemned. Honor comes to the author, not to the appropriator.

Originators have and are entitled to many advantages. Purchasers prefer to deal directly with them rather than with plagiarists or unauthorized copyists. More confidence is bestowed upon them. They do business on their own brains. The articles they offer for sale are more fully perfected and usually better made, for imitators of necessity are behind the times in designs and experience. The person that has invented a machine, worked it through all experimental stages, perfected it and stood by it for many years, is the person to go to for that machine. He can best tell how it should be used and what can be done with it. He has followed the market closely and knows best what purchasers desire.

We would not be understood as saying that the reproduction of first-class tools is of necessity discreditable, for undoubtedly it is of great advantage to all concerned, when it is the result of satisfactory arrangements between the parties reproducing and the inventor or owner. Those reproducing on such terms are substantially in the same position as the originators. They have received as far as possible the benefit of the advice and experience of the originators.

Relating to the Piece-Work Question.

In connection with the discussion of the subject of piece-work, which has been going on in our columns for some time, the extracts given below, taken from the published writings and correspondence of William Denney, who, during his life, was a prominent and successful shipbuilder in Scotland, universally respected for his uprightness of character, as well as engineering and business ability, will, no doubt, prove interesting. The extracts given are selected by *Engineering* from a history of his life, by Prof. A. B. Bruce. In one of his works, treating upon economic questions connected with manufacturing industries, he says:

It is a grievous and mean thing to see men, otherwise good and upright, slinking back to work at benches they have been neglecting for perhaps a good part of an hour, with a shame that is but ill concealed, in searching for tools that are cold from the want of their hands. This is a sight I could show a stranger almost any day in our own yard, and it is the curse and degradation of time wages which alone make it possible. You need not judge these men harshly, for I think days' wages so direct a temptation to carelessness and dishonesty that some excuse may be made for them.

Piece-work was introduced in his works, and carried out to the fullest possible extent, and he writes of the result as follows:

We have found, in testing such piece-work, that the best method is to compare the earnings made by these piece-workers in a given period with the time wages which they would have received for the same period; and it is the duty of one of our partners to control this section of the work, and he does it almost invariably to the advantage of the men. Our idea is that the men should be able to average from 25 to 50 per cent. more wages on such piece-work, within a given time, than their time wages would amount to. There are occasional and exceptional cases where the results are less or more favorable. Where they are less favorable we consider them to be not only a loss to the men, but disadvantageous to ourselves; and our reason for this is very clear, as, unless the men feel that their exertions produce really better wages, and that increased exertions and better arrangements of work will produce still further increases of wages, there is an end to all stimulus to activity or improvement. . . . . .

The method of piece-work is one which cannot either be approved or condemned absolutely, but is dependent upon the spirit and the way in which it is carried out for the verdict which should be passed upon it. It is imperative in such kinds of piece-work as by their nature cannot be reduced to regular rates, that either the employer should take the responsibility of safeguarding his workmen's interests, or that the workmen themselves should, by such a method as I have suggested, obtain an effective control over them.

The method described was:

When the heads of a business are absentees or indifferent, the most effective way in which the workmen can control such piece-work would be by taking care that the standard of time wages was always kept perfectly clear and effective, and that regular comparisons between this standard and their earnings per hour on piece-work were made. Such comparisons would immediately enable them to arrive at a correct conclusion as to whether the prices paid them were sufficiently profitable.

Mr. Denney believed in taking pains to secure brain-work to accompany and direct that done by hand, and in a letter to a friend spoke of his plans thus:

(*a*) Rules as to the admission by examination of apprentices and others into the shipyard offices; (*b*) the same for our engine works; (*c*) rules for the awards committee, to guide them in rewarding the workmen for inventions or improvements. A similar scheme of awards has been begun in our engine works. Our attempts to stimulate the intelligence of our employes have developed in two forms, corresponding to the main divisions of those employes. First, by examinations, we have tried to secure a supply of apprentices and others for our offices, elected for ability and steadiness, and with some knowledge suitable for the careers before them. Second, we attempt by rewards to stimulate the minds of our workmen directly to invention, and to a continual criticism of the methods of work, tools, and machines employed by them.

In another letter he says:

Believe me, the common people are sound at heart. If they were only led by men inspired by the sense of duty, and honor, and sympathy, they would little by little free themselves from their faults and sins. But nine-tenths of our employers, and their wives even more than themselves, are devoted, heart and soul, to the merest wealth-getting and tuft-hunting, when dominant in any character two of the most disruptive and revolutionary causes of the day.

Where the Boy Comes in.

In our reference, in this issue, to what we entitle sharp practice on the part of an English firm, we omitted to show—and we take the statements from the respective catalogues—where the American boy comes in. That is, we did not show the difference, in a productive point of view, between the American and the English boy. We refer just now to the screw slotting device as brought out by Brown & Sharpe, and copied by the English firm that figures in the matter.

We are not able to detect any difference between the original Brown & Sharpe engraving representing this machine and the copy of the English firm. Furthermore, the appended descriptions are identical. But when it comes to production, the Yankee boy flourishes. For example, Brown & Sharpe say that a boy can slot from ten to fifteen thousand screws per day. Now, from some knowledge in the matter, we know they have understated, rather than overstated this. It is, to say the least, a very modest statement of what can be more than verified.

But when we come to the statement of the English firm, that with the self-same (copied) device "A boy can slot from four to six thousand screws per day," we are impressed with the fact that the Yankee boy is way ahead of his English contemporary. It is a triumph for the American boy. That is where the boy comes in.

FIG. 1. STANDARD OIL CUPS. FIG. 2.

Standard Oil Cups.

Fig. 1 of the accompanying illustrations shows an oil cup intended for use in positions where it remains stationary, as for line shaft bearings or for crank-pin bearings which are oiled by a wiper used in connection with the cup. In this style of cup the cover rests loosely upon the glass, and can at any time be simply lifted up for filling.

The cup shown in Fig. 2 is for use in positions where the cup itself has a motion, and on this account the cover is provided with a leather washer and is held firmly in place by the knurled nut or collar, shown above. The opening in the stem below is also covered with glass, to prevent the oil being thrown out. In other respects the cups are alike, and the description of the feeding device applies to both. The oil enters the central stem through two holes, one of which is shown near the bottom of the cups. The rapidity of the flow from this stem is regulated by the position of the pin *A*, which is threaded near the top, and turned by the knurled collar, shown above the springs *B*. There are two of these springs riveted to the knurled collar and pressing upon the flange of the notched collar *C*. This flange has a slot in its upper face, with which the end of one of the springs engages, so that, if the collar *C* be lifted up sufficiently to disengage the notch, it can be turned round to any desired position, carrying the springs and the pin *A* with it. Upon releasing the collar *C*, the springs force it downwards again, engaging the teeth and locking the device in the desired position. The flow of oil can be entirely shut off at any time by lifting the spring *B* out of the slot in the collar *C*, and screwing *A* down to a seat, without disturbing *C*. This enables the exact conditions and feed to be restored at any time, and when the rate is to be changed it can be done by moving one or more notches, thus giving a very fine adjustment, which will infallibly be retained until purposely altered.

With these cups there is furnished also a very neat and complete system of devices for oiling moving journals to which the cups cannot be directly applied, and which are therefore oiled by a wiper which takes the oil from the bottom of the cup, as it passes.

The manufacturers are A. J. Wilkinson & Co., Boston, Mass.

LETTERS FROM PRACTICAL MEN.

That Stick in the Barrel.

Editor American Machinist:

I always read the answers to questions in the AMERICAN MACHINIST the first thing on receipt of the paper. In the issue of February 7, 1889, I found one that I thought I had a theory for; I refer to Question No. 52, of Mr. Lee Whitaker.

Last winter was very cold here on the coast, and, as I had been told the same yarn about the stick in the tank, I thought I would try it (but not on one of the tanks of which we have three that are exposed). I let a hogshead fill about three-fourths full of rain water, and took a pine stick, about 1¼" in diameter, and stood it up in the center of the cask (which stood on end with one head out), and let it freeze there. I think this was in December. The cask stayed there all winter, and I think must have frozen solid, but in the spring, after the ice had thawed from the sides, I found that the cask was tight, and, so far as I could see, unharmed.

I think the reason for this is that, as the water freezes, the air that is in the water is expelled, and is forced out of the pores of the wood. I think if a close-grained piece of wood is used the results may not be the same as with an open-grained piece. This is only my opinion. GEO. E. DAVID, Eng.

U. S. Fish Commission, Woods Holl, Mass.

"Piece-Work."

Editor American Machinist:

The letter of Mr. Godfrey Whitaker, in your issue of January 10, brings out more fully a point touched upon in my last communication on the above subject.* He instances a case given by "Day-Pay," in which a planer hand, doing some work at the original price, would earn about $55 per week, and this he terms "an amount out of all proportion to the market rate of the class of work being done."

What I desire to point out in this is the implied assumption that the amount a man earns is the standard of comparison for the market rate. Now, in the case referred to, if we assume the original man to have been an average workman then the additional work done by the second, or piece-work man was so much above the average, and this was

* [It will be understood by the reader that Mr. Rose had forwarded his previous article, to which he refers, before reading Mr Whitaker s communication.]

again so much saving in the cost of machine, since the machine under piece-work did so much more work than under day-work, while it is not to be overlooked that, if the same ratio extended throughout all the work, the whole shop would do so much more work. These increased profits belong entirely to the employer, of course, and in addition he should reap a benefit from the piece-work price, say 25 per cent. of the day-work price to begin with.

The principal difficulties I have found in introducing piece-work are: 1st. The men have not a due share of confidence in themselves; they cannot see how they can do enough much more work, piece-work, than day-work, to make it pay the employer and themselves too; and 2d. They fear the cutting of prices, as explained in my last communication. There are other difficulties, of course, especially in the case of repair work. For example, jobbing is done at so much per day to the customer, and the longer a job takes the more the employer gets for it. In all my experience, however, I never knew an employer to like a job spun out in order to increase his bill. There is, indeed, a certain degree of honor under temptation that is highly creditable to the machine trade.

But suppose a piece-worker, being an unusually expert workman, reduces the usual and accepted time by an half, and, if the employer only charges the actual time spent on the job, he is a loser by the extra skill and piece-work. I knew a case of this kind in which a new connecting rod was the work and the piece-worker did it in a surprisingly short time. Now several other such rods had been done in the same shop, and the employer said as follows: "If we only charge the actual time on this rod we shall get into trouble, because it is so much less than what we have charged others for the same job, and they are sure to hear of it, so you had better make up the usual time by extra finishing it all over."

The man was a day-worker but had laid himself out to show what he could do. Well, he pitched in and got up that rod like silver-plate; it looked like a piece of C. H. Brown's work, or like the Putnam lathe finish at the Centennial.

Along came the customer's engineer, and he says: "What am I going to do with that rod? Are you going to send me a scarlet plush-covered table to lay it down on; I'm afraid to touch it. Just wait till the boss sees his bill, and there'll be music around these diggings," and there was; for he said he didn't order and would not pay for that kind of finish. When told it had cost no more than the usual price he was somewhat appeased, but still not altogether satisfied.

The real advantage of piece-work is that it picks out the best men, and, *under a fair system*, enables them to get paid for their extra skill, which cannot be done under day-work.

Why can't it be done? Well, because in the first place it takes piece-work to bring out all there is in a man; in the second place, if the best men were picked out and paid as much more than the others as they are worth, there would be discontent and trouble, because there would be among the average, or even among the poorer class of men, some who would not believe they were not as good as the best men, who honestly did not know their own want of skill. Some of the worst workmen I ever knew really thought they were extrordinarily good men. This is the reason that there is so little range between the ordinary day-pay of the best and worst workmen, and it is the best men that are unavoidably the sufferers under the day-work system. I know a man who once worked for me on a 10-inch swing lathe, earning over $30 a week piece-work, who took it into his head that he was a first-class vise hand, a better one than he was as a lathe hand, and has been working for from $15 to $18 in different shops at vise work, whereas, if he had only gone into a large locomotive shop or marine shop, and stuck to small lathe work, he could always earn as much as I paid him. He is one of those men who always has *bad luck*, as he says, the fact being, of course, that he don't earn good luck; for in my experience nothing has been so clearly, universally and decisively proven as that the man who always has "bad luck" gets just what he deserves: doesn't make his own luck, as others do; is of very little use to himself, and of no use to anybody else. I have a case in hand now, of a man who is out of work about five-sixths of his time, and always appealing to his friends or old-time acquaintances for help; he claims to be one of the very smartest men in the trade; knows everything, of course; but between you and I, Mr. Editor, I begin to suspect that (as usual with the man who knows it all) his knowledge will never press very hard upon him, or weigh him down. He, of course, is dead against piece-work, because it *ruins the trade*.

JOSHUA ROSE.

London, England.

Oil in a Boiler.

Editor American Machinist:

Regarding the answer to Question No. 63, Feb. 14, 1889, I beg leave to say that the same objections will hold good of any compound I have ever used, and while it may hold that some oils will cause foaming, it is also true that a properly prepared natural oil, intelligently used, will not cause foaming, unless used with alkali water.

The fact is that, very largely, foaming may be induced by changing from the use of oil to a compound the base of which is some form of soda, or *vice versa*.

I have used natural oil as a scale solvent, have tested it as thoroughly as I could, and have had no trouble from foaming that could be fairly charged to the oil. But in changing from oil to sal-soda, foaming ensued.

The quality of the oil would cause settling on the lower sheets of a tar-like substance. I saw a boiler opened a few weeks ago, where the oil used, and the poor judgment added, had combined to produce the conditions you objected to. Clearly this did not condemn a proper use of natural oil.

There is a very wrong impression afloat concerning oil, many persons assuming that any kind of oil is suitable. On this point I agree with you in condemning oil generally, for there are so many hopeless idiots in this world who would proceed to use anything from axle-grease up.

A case came to my notice where the engineer had been told to use oil, and he gathered the drip pans from under the line shaft, and put in two gallons of such refuse. The genial boiler maker said he "guessed three new sheets would do." Such cases emphasize the caution in recommending oil without carefully specifying what kind and how much.

Nevertheless there are a great many boilers kept free from scale by the careful use of natural oil, and many high ones in the world of mechanics have endorsed such use.

The action of the oil on valves, joints and packings, is beneficial, unless it is a joint packed with mud or scale.

The only objection I have against the use of oil applies equally well to every compound I have ever tried, that it is not the correct way to cure the evil of scaling. Yet, where compounds must be used to remove scale, and if careful tests show that a proper oil will do the work, it will be found that it is vastly better than an acid or alkali mixture.

T. T. PARKER.

Invention in the Foundry.

BY W. A. JONES.

There is probably no trade in which true inventive genius is called upon oftener than that of a moulder; particularly in a jobbing shop, where he is called upon to make all manner of changes, and to turn out what his customer wants, with the least possible expense. A very common error is that it is economy to have the moulder make the changes in the sand, instead of having it done in the pattern shop, when, in reality, the pattern maker could make a new pattern in about the same it would take the moulder to make the changes, and a much better job could be turned out. On the other hand, there are many jobs where one or two hours' extra time in the foundry will save four or five times as much time in the pattern shop.

Not long ago an order came in for a spur gear 20 inches diameter, 1¼-inch pitch and 6-inch face, with arms in the center. Upon examination it was found that the only pattern at hand that could be made to fill the requirements was one with a 4-inch face, and in which the arms were tight and solid. Of course it could be drawn the same as a pulley rim, and the arms tucked under in coming up; but this would bring the arms out of center, which would not answer.

The job could be made in several different ways, but the question was, how could it be made the cheapest?

Without going into any of the details of how it might be made, I will simply describe the manner in which it was made. A pair of hubs of the right diameter were found, that were flush with the rim on both sides, and the gear itself was used as a core-box by laying it down on a core-plate with the hubs in position on both sides; the lower half was rammed up, and parting made exactly the same as though bedding it in, in green sand; then, after putting on the parting sand, the top half was rammed up and struck off level with the top of the pattern. A core-plate was placed on top and rubbed down to place, after which the gear and the upper half of the core were lifted off from the core-plate, leaving the lower half of the core on the plate. The gear was then carefully turned over on the upper plate and drawn off, and the halves dried, blacked, and pasted together.

The gear was moulded in an ordinary three-part flask, the cheek being the same width as the face of the gear. The drag was rammed up and leveled off, and a plain parting made. The hub was made by using a plain, round plug, the same diameter as the hubs used in making the core, and of the requisite length.

The pattern was placed in the center of the flask, and the cheek and inside of the gear rammed up and drawn to the required width, and a straight parting made over the entire flask. The cope was then rammed up, leaving an opening about a foot square in the center, after which it was lifted off, the sand removed from over the arms and the pattern drawn.

The cheek was then lifted off and finished, and all the sand from the inside of the pattern removed except one inch, which was struck off level, and the dry sand core placed on top of it; and after bedding in the hub through the opening left in the core, one inch of sand was placed on top of the core and the parting made over the hub, and the joints of the core and green sand nicely dressed, the cheek was put on, and cope returned, and the opening left in it rammed up over the top of the hub, after which it was taken off the hub finished, and mould finally closed. By this means a good casting was obtained, and at no very great expense.

There may be an easier and more simple way to accomplish the same result, but this seemed the best way that presented itself.

La Metallurgie describes a new alloy which is useful when metals are required to be soldered together at a low temperature. Finely divided copper is obtained by adding zinc to a solution of sulphate of copper. From twenty to thirty parts of this copper, according to the hardness required, are mixed in a cast-iron or porcelain mortar with concentrated sulphuric acid, to which is added seventy parts of mercury. The amalgam thus formed is thoroughly washed with water, in order to remove the sulphuric acid, and after being left untouched for some time it becomes sufficiently hard to scratch lead. In using the alloy for soldering it is warmed until it assumes the consistency of wax, in which state it can be applied to the joint.

The Cramps appear to be pretty successfully demonstrating the ability of American shipyards to produce anything the Government requires in the way of fighting vessels. At this writing the gunboat "Yorktown" appears, under inspection, to be equal to all the requirements. An extended sea trip will fully test her, and there is little reason to doubt that the result will be entirely satisfactory. It is not necessary to go abroad to find everything necessary to put the navy of the United States in a condition to do honor to the country.

State Laws on Boiler Inspection.

There is an emphatic disinclination, on the part of the owners of steam boilers, to permit the passage of any State law calling for the inspection of boilers or the licensing of engineers. In New Jersey an attempt has been made for eight or nine years to bring about the passage of such a law, but it has been steadily, and so far successfully opposed, by boiler owners and users. And this is as true in other States as it is in New Jersey. In the meantime, an account of the explosion of one or two boilers furnishes a standard item for the daily press.

Perhaps it would be an effective way to bring about a change in public opinion in regard to boiler explosions, if in every case a record were kept of all the circumstances attending the explosion, and so kept that the record could be examined at any time. A few years of this would, we are persuaded, convince the most skeptical that boiler explosions, with the attendant loss of life, were not mysterious dispensations of Providence, but rather the outcome of carelessness and incompetency. No man in a city in this country is allowed to store high explosives in his cellar, but in most cities he can place a boiler that no one knows the condition of, and put it in charge of any ignoramus that can be hired for seven or eight dollars a week.

In plenty of other instances the law interposes between the citizens and the individual, but in this instance the necessity of such interposition is overlooked. The reason for this is apparent. There is not one in ten of the legislators of the country that has even the most elementary ideas of the question. A few intelligent engineers and mechanics in our State legislatures would be able to show the value of laws governing the use of steam boilers, both in an economic sense and in regard to safety. But such men, except in very rare instances, have no part in making the laws by which we are governed.

Practical Drawing.

BY J. G. A. MEYER.

SEVENTY-FIRST PAPER.

Problem 83a.

543.—*Development of Boiler Plates.*

Fig. 447 represents a longitudinal section of a small return tubular boiler; one-half of Fig. 446 represents the end, and the other half represents a cross-section of the same boiler. It is suitable for a small yacht, requiring an engine with a cylinder about 7″ diameter and 8″ stroke.

Our principal aim in giving the drawing of this boiler is to enable us to apply the solutions of some of the problems previously given to the manner of laying out the sheets or plates of a boiler; that is to say, to find the correct shape of its plates before they are bent or flanged.

Since, then, our aim is simply to furnish a good practical example in laying out boiler plates, we have, for the sake of simplicity, and also to avoid complications, left out many of the braces, all the stay bolts, and the necessary hand holes. The positions of rivets are indicated simply by center lines, and, indeed, these center lines of rivets are all that is required on a working drawing; the representation of rivets along the whole length of a seam is unnecessary; in fact, to do so on a working drawing is a waste of time.

In Fig. 447 it will be seen that the rear end of the boiler has a peculiar form, that is to say, the rear head is bent near the bottom so as to form an obtuse angle with the bottom of outer shell. This form is seldom if ever adopted for boilers of this size; but large boilers, set athwartship, often require this form, so as to clear the sides of the vessel.

Hence, in order to make the problem now before us as instructive as possible, we have adopted this particular form of boiler.

It may be remarked here that laying out the plates for this boiler will be excellent practice for the student; it will show him the usefulness of the foregoing problems, many of which may have appeared to be simply geometrical problems, and not of much practical value. Although in many of the foregoing problems we have dealt simply with geometrical solids, yet the principles set forth in their solutions are of great practical value, and are not only applicable to the solutions of practical problems, such as we meet with in ordinary boiler work, but are applicable to a wide range of practical problems of quite a different character.

Some of our readers may say that there are many boiler makers who have never seen a geometry, who can lay out all the work required of them. This is true, but it is equally true that if these men are called upon to lay out work somewhat different to what they have been accustomed to, they cannot proceed with such confidence as those who are familiar with geometry, and the former will not be so free from making mistakes as the latter. No matter whether the boiler maker is quite unconscious of following any geometrical principles in laying out his work, or whatever names he may give to his methods, the fact remains that the desired correct result cannot be obtained in any other way than by strictly following that which geometry teaches us.

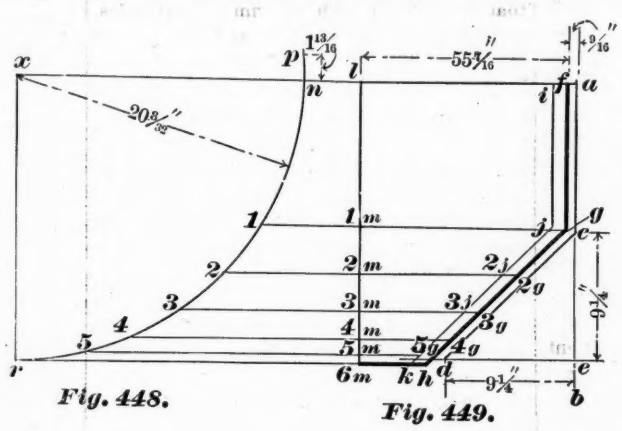


Fig. 448.

Fig. 449.

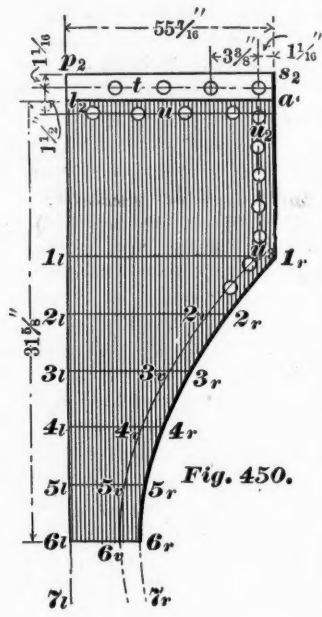


Fig. 450.

Now, assume that a drawing, such as shown in our illustration, has been sent to us, and that we are called upon to lay out some of the principal plates which enter into the construction of this boiler. Let us commence with the bottom sheet *F* of the outer shell. To lay out this sheet we shall need two projections, such as are shown in Figs. 448, 449; and since, for practical purposes, these two views must be drawn full size, we shall assume that these are now to be drawn on a blackboard, with which all good boiler shops are provided.

In Fig. 447 we see that the outer diameter of the shell is to be $40\frac{1}{2}$ inches, and its thickness is $\frac{5}{16}$ of an inch. Our first step will be to reduce the problem to such a one in which the thickness of metal can be left out of consideration, and therefore we follow the instructions given in Problem 75; thus, from the outer diameter of the shell subtract the thickness of the metal, hence we have

$$40\tfrac{1}{2} - \tfrac{5}{16} = 40\tfrac{3}{16}$$

inches for a new diameter, and the radius will be

$$\frac{40\frac{3}{16}}{2} = 20\tfrac{3}{32} \text{ inches.}$$

We may now consider that we have to find simply the development of a cylindrical surface (a geometrical surface, that is, a surface without thickness). But in Fig. 446 we see that the shell is made up of two plates, each forming a little more than one-half of the shell; therefore at present we have only to develop a little more than one-half of a cylindrical surface whose diameter is $40\frac{3}{16}$ inches. Hence, draw (Fig. 448) a horizontal line *x n*, and also a vertical line *x r*, intersecting each other in the point *x*; from this point as a center, and with a radius of $20\frac{3}{32}$ inches, describe an arc *n r*, and let it extend to point *p* above the line *x n*; the distance between the points *p* and *n* must be equal to one-half the lap, namely, $1\frac{1}{16}$ inch, as shown in Fig. 446. Here then we have drawn one half of an end view of that portion of the cylindrical surface which is to be developed.

Fig. 449.—Prolong the horizontal line *x n* towards *a*, and at any convenient distance from the center *x* draw the vertical line *a e* intersecting the horizontal line *x r* in the point *a*. Make *a e* equal to one-half of the inner diameter of the shell; that is, equal to $\frac{39\frac{7}{8}}{2} = 19\frac{15}{16}$ inches. From the point *e* on the line *a e* lay off a point *c*; the distance between the points *e* and *c* must be equal to $9\frac{1}{4}$ inches, which is the height from the bottom of the inner surface of shell to the line at which the back head is to be bent, as given in Fig. 447; also from the point *e* on the horizontal line *e d* lay off a point *d*; the distance between the point *d* and *e* must also be equal to $9\frac{1}{4}$ inches, as marked in Fig. 447; join *c* and *d* by a straight line. Now the lines *a c* and *c h* represent a projection of the lower portion of the outer surface of the back head.

In Fig. 447 we see that the shell is to extend to within $\frac{9}{16}$ inch of the outer surface of the back head, therefore in Fig. 449 draw a line *f g* parallel to *a c* at a distance of $\frac{9}{16}$ inch from the line *a c*; we must also draw a line *g h* parallel to *c d*, at a distance of $\frac{9}{16}$ inch from *c d* and intersecting *f g* in the point *g*. Through the point *r* draw a horizontal line *r h*, meeting *g h* in the point *h*. If so far the lines have been correctly drawn, then the vertical distance between the lines *d e* and *r h* will be $\frac{5}{32}$ of an inch. In Fig. 447 we see that the centers of rivets are to be placed $1\frac{1}{16}$ inch from the edge of the plate, hence in Fig. 449 draw the line *i j* parallel to *f g*, and the line *j k* parallel to *g h*; the distance between the lines *f g*, *i j*, and also that between *g h* and *j k* must be equal to $1\frac{1}{16}$ inch; the lines *i j* and *j k* represent the center lines of the rivets. Lastly, on the line *x a* lay off a point *l*; the distance between the points *l* and *f* must be equal to $55\frac{7}{16}$ inches, which is the length of the plate, as given in Fig. 447; in our figure, the distance between the points *l* and *f* is considerably less; this has been done to save space, and will not make any difference in the construction, so long as this is distinctly understood. Through the point *l* draw a vertical line meeting *r h* in the point 6*m*. The lines *l* 6*m*, 6*m h*, *h g*, and *g f*, which, for the sake of distinction, have been drawn a little heavier than the other lines, form the outline of the other view of the surface which we have to develop.

Through the point *g* draw a horizontal line *g* 1, intersecting the arc *n r* in the point 1. Divide the arc 1 *r* into any number of equal parts, say five, and thus obtain the points of division 2, 3, 4 and 5; through these points draw horizontal lines, intersecting the line *g h* in the points 2*g*, 3*g*, etc.; also intersecting the line *j k* in the points 2*j* 3*j*, etc., and the line *l* 6*m* in the points 2*m*, 3*m*, etc. This completes our preliminary projections required for laying out the plate.

Fig. 450.—We shall now assume that the outline of this figure is to be drawn directly on the plate. Parallel to one of its edges, and close to it, draw the straight line *l* 6*l*, and through the center of the plate draw the line 6*l* 6*r* perpendicular to *l* 6*l*. Now, since the arc *n r* is equal to one-quarter of the circumference, make the line *l* 6*l* equal to $31\frac{9}{16}$ inches, which is equal to one-quarter of the developed circumference nearly. From the point 6*l* lay off in succession on the line *l* 6*l* five spaces, each equal to one of the spaces laid off on the arc *n r*, and thus obtain the points 1*l*, 2*l*, 3*l*, etc. Through these points, and also through the point *l*, draw lines perpendicular to *l* 6*l*. Make 6*l* 6*r* equal to 6*m h*; 5*l* 5*r* equal to 5*m* 5*g*; 4*l* 4*r* equal to 4*m* 4*g*, and so on in succession; the last line, 1*l* 1*r*, will, of course, be equal to 1*m g* or *l f*. Through the points 6*r*, 5*r*, 4*r*, 3*r*, 2*r* and 1*r*, draw a curve; also through the point 1*r* draw a line parallel to *l* 6*l*, meeting the line *l* a_2 in the point a_2, and thus completing the outline of the shaded surface, which is the development of the cylindrical surface represented by the arc *r n* in Fig. 448. To this we must now add one-half of the horizontal lap. The manner of doing this and the manner of locating the river holes in Fig. 450 will be explained in out next paper.

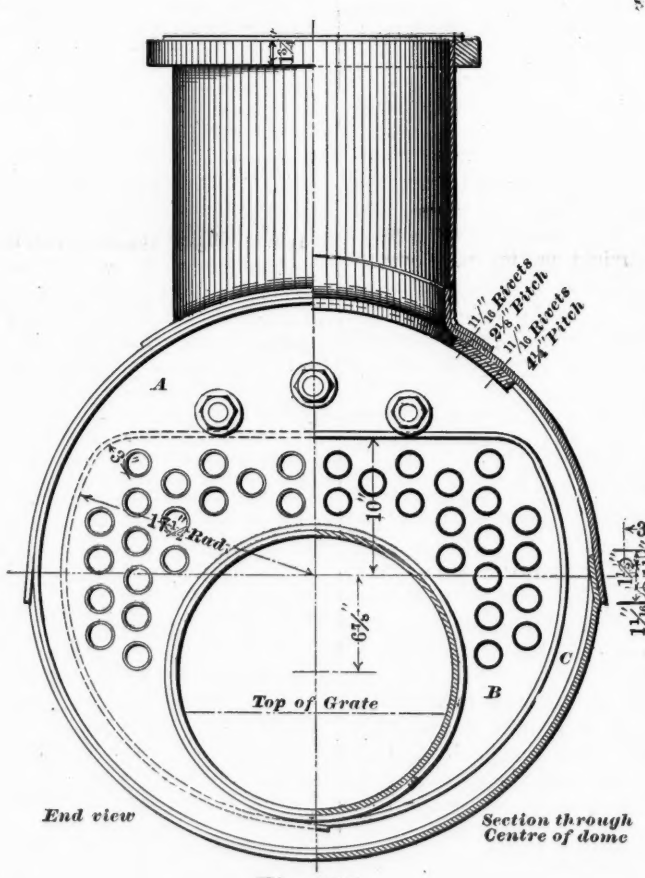


Fig. 446.

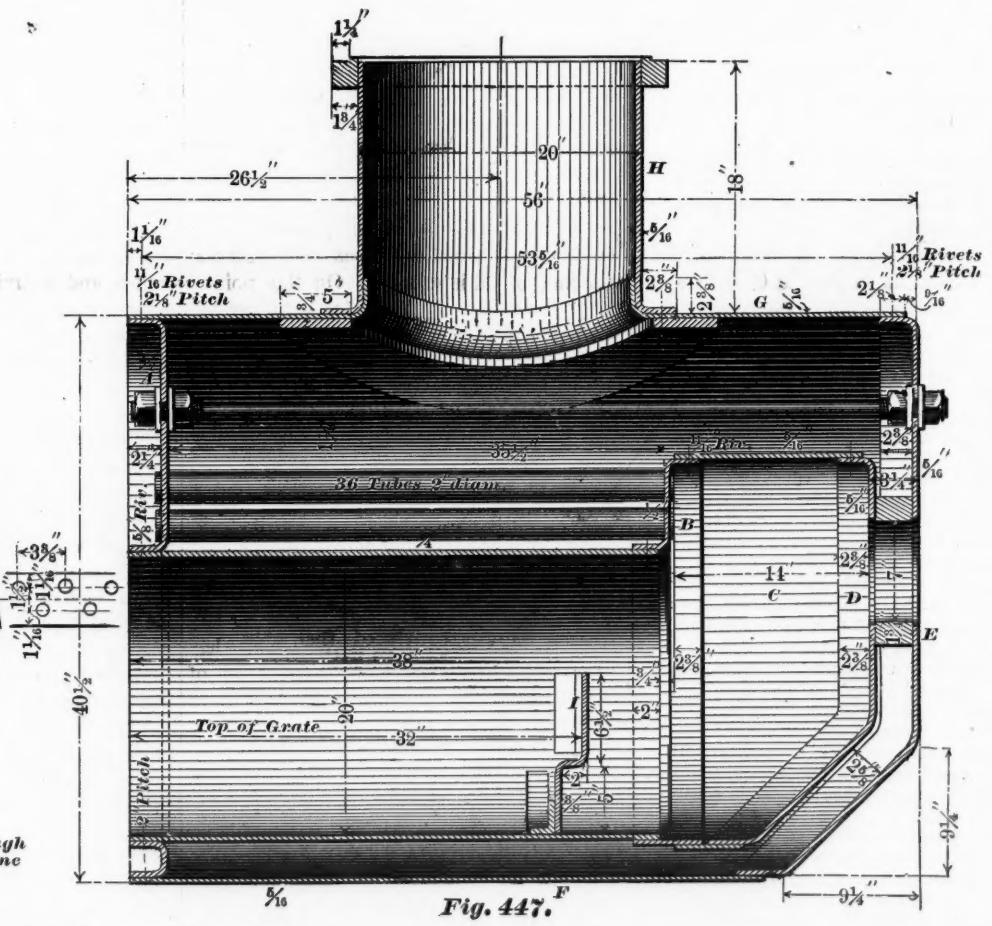


Fig. 447.

PRACTICAL DRAWING.

P. Barnes, manager of the steel department of Jones & Laughlins, Pittsburgh, Pa., has arranged a course of Saturday evening lectures on engineering and manufacturing topics, given at the Curry University. Everybody is welcomed to the lectures, and no doubt much good will be accomplished.

It is said that there will be more than one thousand American exhibitors at the Paris Exposition.

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NEW YORK, FEBRUARY 28, 1889.

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The View from Drafting-room Windows.

In choosing a location for the drafting-room, there is one point to be considered, which we think is not as well understood as it ought to be, and that is the great relief to the muscles and nerves of the eye, afforded by the opportunity for frequently focusing it for an instant upon distant objects. It should be remembered that the eye is provided with muscles whose special function it is to adjust the eye to the proper focus suited to the distance from the object looked upon, and that these muscles are provided with nerves, whose function it is to control and direct them. It is by the action of these nerves and muscles that the relative positions of the lenses of the eye are changed to suit varying distances, or held steadily at a given adjustment when required. To hold the eye constantly and steadily focused upon near-by objects, such as the drawing board, requires a constant and severe effort of the nerves and muscles, and results in real nervous and muscular fatigue, the same as is caused by the effort to hold the hand or arm continuously in one position hour after hour, only that, as the eye is more delicately constructed and more sensitive, it is more easily injured by such treatment.

In walking about, or when engaged in most of the ordinary occupations of life, especially those pursued out of doors, the eye is frequently and naturally lifted to the horizon or to the most distant point of view, thus giving these muscles an opportunity for action and change of position, the result being that they are relieved of the fatigue caused by the strain of maintaining a constant and unvarying position.

If it is possible to do so, drawing tables should be so situated that the draftsman, as he occasionally glances up from his board, should find his eyes resting upon objects not less than a mile distant, and five miles is still better. In the crowded city this is, of course, not always possible, but where shops are built in the suburbs it is usually possible, and affords another reason for locating them—where they are often found—in the second story above the office, the rest of the buildings being only one story in height.

Not long since we were in the drafting-room of a large establishment, and in conversation with the chief he congratulated himself upon the fact that the windows of the room afforded a bird's-eye view of the city two miles distant, and a beautiful stretch of landscape intervening. He considered it fortunate, not only because the situation was more pleasant and the room better lighted than if it had been on the ground floor, but because he was convinced that ability to direct the eye to distant objects, when glancing up from the drawing, had a positive beneficial effect, and did very much to enable the eye to stand, without injury or distressing fatigue, the strain of the work imposed upon it. It is not improbable, either, that the variety of colors which meet the eye in looking over a landscape, help to afford relief after looking for some time upon black lines drawn upon white paper.

Altogether we think this is a matter which is worthy of attention by proprietors in locating the drafting-room, and by draftsmen in choosing the particular window or direction in which their eyes shall be directed when not upon the board.

Good Iron or Good Engineers.

A newspaper item says, "Tennessee iron-makers plume themselves not a little over the fact that no boiler made of their famous charcoal blast iron has ever been known to explode." If this is true, it simply indicates that their iron has not been used for making the boilers of portable engines used for driving threshing machines, nor for saw-mill boilers. The engineer (?) who wears a suit made of bed-ticking, and is the revered hero of the youngsters of the farms, can find ways of blowing up any boiler, no matter what kind of iron it is made of, and his brethren of the saw-mills are equally efficient and ingenious.

The papers report the explosion of a saw-mill boiler in a small town of West Virginia, the other day, by which six persons were killed outright, one of them a woman who happened to be passing at the time. Such catastrophes will continue to occur, we suppose, until communities are aroused to the point of insisting that every steam boiler shall be in charge of a man who knows something more than barely enough to throw in plenty of slabs and cuttings into the fire-door. Most saw-mill owners do not care for an economical performance of their engines. Economy of fuel is no object to them, because there is always more waste lumber and scraps about the mill than can be consumed by the most wasteful engine, managed in the most wasteful manner. This leads to the employment of men to "run" the engines, who are in no sense engineers, and when the inevitable explosion takes place it is only the more disastrous the better the iron of which the boiler is made may be.

Pig-iron Storage Certificates.

The speculative tendency of modern trade seems at last, after many years of effort upon the part of those interested, to invade the pig-iron markets, and it is not unlikely that, before long, there will be a regular speculative trade in pig-iron certificates, which will be similar to the Scotch warrants with which the various British speculative markets are supplied.

A company is to be organized with a capital of $2,000,000, which will receive pig-iron for which there is no immediate demand, charge the owner for storage, and issue certificates representing its value, and which are to be bought and sold, and presumably speculated in after the manner of the stock exchange. Of course it is claimed that this will be beneficial to all the parties concerned; to the producer because it will afford him a ready market for his surplus, and relieve him of the burden of carrying it as he does now, and to the consumer because it will result in very much steadier prices than now prevail.

The sublime cheek which enables the promoters of this scheme to make the assertion that such speculation will result in steadier prices is something which the ordinary mortal can never hope to fully appreciate. There can be no speculation in anything without fluctuation in prices, and the more fluctuation the greater the speculative opportunities. Speculators understand this perfectly, and it is the constant aim of the unscrupulous professional speculator, by hook or by crook, to bring about violent fluctuations in prices. This the speculators in pig-iron storage certificates may be depended upon to do to the inevitable prejudice of consumers' interests, if not to those of producers.

The interests of machinery builders and other consumers of pig-iron lie in steady prices of this their raw material, and we think it will prove to be injurious to them to have it become the subject of dishonest speculation and gambling operations.

We Cannot Classify It.

We publish elsewhere in this issue a communication from a well-known machinery firm in this country, and follow it with the substance of a joint communication from three firms of universal reputation (including the one first named) which we are assured was refused publication in England by journals that discuss mechanical and engineering matters. We publish the letter last referred to, because we believe these firms are entitled to be heard in the matter.

We have examined the subject with care, and while we are not competent to judge of the ethics obtaining in such matters abroad, we do not hesitate to say that in this country it would not pay to do the kind of work to which the communications referred to call attention.

The English firm mentioned has, so far as we are able to judge, copied with commendable exactness a large number of engravings, to all appearance directly from the catalogue of the American firms. It has also in many instances copied the explanatory text from the American catalogues, in some cases reproducing certain slight grammatical errors, probably in its effort to sacrifice everything to the virtue of exactness. On the whole, no one can find fault with the work of copying. It is very well done indeed.

We have admitted our incompetency to judge as to what is considered the proper thing in England as regards wholesale appropriation in machinery designs. In this country, the line would be drawn considerably short of making an entire catalogue out of the efforts of other manufacturers. Doing that would pretty effectually prevent the sale of machinery by the firm putting out such an exhibit.

Here it is very generally—and we believe very justly, in the main—considered that a man who does not know enough to invent a machine, or some part of it, is too ignorant of mechanics to successfully copy it. This may be an old-fashioned view of the case, that does not prevail elsewhere.

There is always a legal aspect to a case, generally a moral aspect, and sometimes an aspect that, for the want of another designation, may be classed under the general head of decency. We shall not attempt to classify this one. It may come under some classification outside our knowledge.

QUESTIONS AND ANSWERS.

Under this head we propose to answer questions sent us, pertaining to our specialty, correctly, and according to common-sense methods.

Every question, to insure any attention, must invariably be accompanied by the writer's name and adaress. If so requested, neither name, correct initials nor location will be published.

(82) C. S., Mount Union, Ohio, writes: A. claims that it will require more power to raise water 60 feet through a 2-inch pipe than through a 1-inch pipe. B. claims it will not. Which is right? *A.*—B. is right.

(83) G. S., Chicago, Ill., asks: What is the greatest number of revolutions, and the highest piston speed made to advantage with a Corliss engine? *A.*—The greatest number of revolutions we know of is 160 per minute, with piston speed of 1,120 feet per minute.

(84) A. B., Boston, Mass., asks: Please give me the method for finding the stress brought on the braces of a boiler with a given steam pressure? *A.*—See answer to Question 314, in our issue of July 23, 1887; also answer to Question 505, December 10, 1887.

(85) C. A. M., Rochester, N. Y., asks: Please inform me what is required of an applicant to secure a position in the U. S. Steamboat Inspection service; and also, what salaries are paid in this service? *A.*—Write to the supervising inspector, George H. Starbuck, New York city.

(86) W. M. P., Taunton, Mass., asks: Is the method for laying out link motion given in your issue of December 4, 1886, applicable to laying out the link motion for a small launch? *A.*—Yes. It is applicable to all link motions of that class; we have used it with good success.

(87) G. W. L., St. Louis, Mo., asks: How can the lap of a common slide valve be determined to give any desired cut-off? *A.*—You will find this subject thoroughly explained in the AMERICAN MACHINIST, Nov. 21, 1885. Your method of finding the required lap will not give correct results.

(88) C. A. S., Salem, Mass., writes: Please state the kind of cement which will securely fasten leather to iron. For instance, I wish to secure leather jaws to a cast-iron pattern maker's vise. *A.*—Wash the iron in hot gelatine, and apply a hot infusion of gall-nuts to the leather, and unite under considerable pressure.

(89) J. E. B., Williamstown, W. Va., writes: Please give us the number of States and the names of some of them which require licensed engineers for running stationary engines, and where is a person to apply for a license? *A.*—We do not keep a record of the local laws of different States, and therefore we cannot answer your questions.

(90) J. P. R., Ottawa, Ont., writes: I would like to know the difference between the fire-boxes and grates used for burning soft coal and those used for burning hard coal. There are no boilers suitable for burning hard coal in this part of the country. *A.*—Generally, the grate area for burning hard anthracite coal is made about 50 to 60 per cent. greater than the grate area adapted for burning bituminous coal. In many cases, particularly in locomotives, water grates are used for burning anthracite coal; for bituminous coal, a cast-iron grate generally answers the purpose.

(91) A. T., ———, writes: Please let me know how many papers the article on "The Modern Steam Plant and its Management" have been published in, and whether I can obtain the back numbers? *A.*—Previous to this issue, three of these articles have appeared, and will be found in our issues of Dec. 31, 1888, Jan. 17 and Jan. 31, 1889. Back numbers can be obtained through any newsdealer or at this office.

(92) W. H. S., Boston, Mass., will find the simplest directions we can give for gearing a lathe in the answer to Question 70, in our issue of Feb. 14. The figures to which you refer are decimal fractions, which are more simple and more easily understood than common fractions. Your best plan for becoming acquainted with them is to take a common school arithmetic and go through the subject. You ought to find no difficulty in doing this, if, as we suppose, you can perform ordinary arithmetical operations.

(93) J. J. F., Columbus, Ohio, writes: What kind of spring spacing dividers would you advise a person to buy, a plain pointed one, or one with the adjustable points as shown in Figs. 130 and 131 in the articles on "Practical Drawing"? *A.*—We prefer the spacing dividers with adjustable points, because if one of the points is injured it can be readily repaired, and both set to equal lengths more readily than when the points are fixed. There are many draftsmen who prefer spacing dividers with fixed points.

(94) J. R. S., New York, asks: Can I pour a ladle of melted copper (from 1 to 3 pounds) into open moulds placed in a tank of water? I have read in your paper of the danger of bringing hot iron and water into contact, but have been told that with melted copper there is no such danger. *A.*—You may pour the copper into the moulds placed in water, provided you do not allow any water or moisture to come into contact with the hot metal. 2. What is the best and most economical way of melting small quantities of copper? *A.*—We do not know of a better way than melting it in a crucible, the same as adopted for melting the ordinary alloys.

(95) J. S., Gibbsboro, N. J., asks: What size engine and boiler are necessary to run a four-wheeled carriage on a railroad track, wheels 22 inches diameter, total weight of car 200 pounds? I want to carry three passengers, average weight of each person is 140 pounds. I want the wheels to make about 60 revolutions per minute, or about 12 miles an hour. *A.*—You cannot run at the rate of 12 miles per hour with 22-inch wheels making 60 revolutions per minute; under these conditions the speed will only be about 6 miles per hour. To obtain a speed of 12 miles an hour we should gear the engine 2 to 1; and adopt 2 cylinders, each 1 inch diameter and 3 inches stroke. Boiler, 2 square feet of heating surface.

(96) W. W., Fort Plain, N. Y., writes: Up to the present time I have been burning under my boiler mostly shavings, sawdust, and waste pieces of lumber, using coal only when other fuel runs short. A broom factory has been started in the same building; I am now burning the waste arising therefrom. But I have been told by one who professes to know, that I will ruin my boiler by burning broom corn; the corn is colored or stained green; the broom makers say it is called "broom coloring." Please inform me if the burning of broom corn so colored will injure an iron boiler? *A.*—The burning of the broom corn itself will not injure the boiler. As to the use of the colored corn, we cannot say whether it will injure your boiler or not, unless we know the compositions used in coloring it.

(97) W. S. D., Halifax, N. S., asks: Are brasses fitted with babbitt metal to within ¼ of an inch of each edge the proper thing for wrist-pin boxes? I maintain that they are not; but I believe that babbitt metal is very good for crank-pin boxes. In wrist-pin boxes the thrust of the piston knocks the babbitt out of shape, and it is almost impossible to keep the engine from pounding with such boxes. I therefore claim that the boxes for wrist-pins should be solid boxes. *A.*—In our opinion you are right in your conclusions. The projected area of wrist-pins is generally smaller than that of the crank-pin, and therefore the pressure per square inch on the wrist-pin is greater than the pressure per square inch on the crank-pin. In many cases the wrist-pins are comparatively very small, and thus causing an excessive pressure per square inch, and this is likely to result in injury to the babbitt metal if such is used. Crank-pin boxes will generally not run cool without babbitt metal.

(98) H. T., Managua, Nicaragua, asks: Will you please tell me how to solder two copper tubes for locomotive boiler connections? *A.*—You may scarf or bevel the ends of the pipe to be joined, then put them together and heat them sufficiently to melt the spelter used for brazing. A better way is to enlarge one of the ends for three or four inches, by heating it and placing it over an arbor. The other end is reduced in size to enter the enlarged end, and then, by placing them together and heating them sufficiently to make the spelter run into the joint, a very substantial job is secured. 2. Can you tell me where I can post myself about tempering? *A.*—We do not know of any definite way by which you can do this, except by practice. There is considerable information relating to the subject scattered through various books and journals, but it will do you little good without practice. 3. How can I set a safety valve? *A.*—The most simple and easiest way is to have upon the boiler a steam gauge known to be correct, and then set the valve so that it will blow when the gauge shows the desired pressure. For computing the proper place for the weight, without reference to a pressure gauge, you will find directions given in the answer to Question No. 312, issue of June 30, 1888. 4. How can I know approximately when the steam gauge and glass tube are right? *A.*—You can test the gauge by comparison with a standard gauge. We do not understand what you mean in regard to the glass tube. You will find the rule for compounding gears on a lathe in our answer to Question No. 70, issue of Feb. 14.

(99) C. L., Brooklyn, N. Y., asks: 1. What is the best angle for a conical (taper) friction pulley? *A.*—It depends upon circumstances, and may be from 8° to 30°. You will find the subject discussed in the AMERICAN MACHINIST of June 11, 1887. 2. Is not the power capable of being transmitted (theoretically) by such a friction pulley independent of the surface in contact, when the total pressure and surface speed of friction is the same? *A.*—Yes, if the total pressure between the surfaces remains the same. But it must be remembered that the proportion which this pressure bears to the end thrust used to throw the clutch in, will vary with the angle. 3. Is not Mr. J. G. A. Meyer, in his 84th article on "Locomotive Construction" (Feb. 7th) mistaken when he says that enlarging the diameter of crank-pin will occasion a loss of work due to friction? *A.*—No. There will really be the same friction, but this friction will act at a greater leverage and through a greater distance during each revolution, which will increase the loss of work by the friction.

(100) T. H. M., Richmond, Ind., asks: How many gallons of water will be discharged through an opening 1-16 inch diameter in one hour at 65 pounds' pressure? Please give a rule for computing same. *A.*—The amount discharged will depend somewhat upon conditions which you do not state, the most important being the shape of the opening and the length of that part of the tube which is 1-16 inch diameter. Assuming this length to be equal to 3½ to 4 times the diameter, the discharge will be about 46 gallons per hour. To find this amount, we divide the pressure 65 pounds, by .434, which gives us the height of a column of water which would produce an equivalent pressure — 150 feet. From this the velocity of the flow is computed by the formula $v = \sqrt{2\,g\,h}$ where v = velocity, g = acceleration due to gravity, or 32.2, and h the head, or height of the column. This means simply that the head (150 feet) is to be multiplied by twice g, or 64.4 and the square root of the product gives the velocity in feet per second, which is 98.3 feet. Then multiplying by 12 and by 3,600 (the number of seconds in one hour) we have the velocity in *inches* per hour. Multiplying this by the area of the opening in square inches, (.00307) we obtain the cubic inches of flow per hour, which, divided by 231, the cubic inches in a gallon, gives the theoretical flow per hour. But for the proportionate length of tube which we have assumed, it has been demonstrated in practice that about 19 per cent. must be deducted from this amount, and, when this is done, we get the answer given above.

BUSINESS SPECIALS

Transient Advertisements 50 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Thursday for the ensuing week's issue.

Gear wheels and g-cutting. Grant, see adv., p. 16.

Link Belting and Sprocket Wheels.
Send for Catalogue of Link-Belting.
Over 50,000,000 feet of Link-Belt in use.
Link-Belt Engineering Co., Philadelphia and N. Y.

Shafting Straighteners. J. H. Wells, Tampa, Fla.

Steel Name Stamps, etc. J. B. Roney, Lynn, Mass.

Duplex Gear Cutters. R. M. Clough, Meriden, Ct.

The best Upright Hammers run by belt are made by Jenkins & Lingle, Bellefonte, Pa.

The Improved Justice Hammer. Williams, White & Co., Moline, Ill., manufacturers.

Berryman Feed Water Heater and Purifier. Benj. F. Kelley, 91 Liberty street, New York.

R. Dudgeon, 24 Columbia st., New York. Improved Hydraulic Jacks and Roller Tube Expanders.

Pattern and Brand Letters. Vanderburgh, Wells & Co., cor. Fulton and Dutch sts., New York.

"Swift" Sight Feed Lubricator; no glass tubes; simple, reliable. Swift Lub'r Co., Elmira, N. Y.

Power measured with guaranteed Dynamometers. Franklin Van Winkle, 91 Liberty st., New York.

New Catalogue of Screw Plates, Taps, Dies, etc., just issued by S. W. Card & Co., Mansfield, Mass.

Davis Key-Seating Machines kept in stock by Manning, Maxwell & Moore, 111 Liberty st., N. Y.

"Bradley's Power Hammers, the best in the world." 20 sizes. Bradley & Co., Syracuse, N. Y.

Fire Brick and Clay Retorts; large variety; special shapes to order. Borgner & O'Brien, Philadelphia.

Selden Packing, for stuffing box, with or without rubber core. Randolph Brandt, 38 Cortlandt st., N.Y.

Brown & Sharpe Mfg. Co., have a line of machinery with S. A. Smith, 23 S. Canal st., Chicago, Ill.

Dynamos, Engines, etc., need Common-sense oil filters; great saving. C. F. Baker, Minneapolis, Minn.

Ice and Refrigerating Machines, 131 sold, and all successful. David Boyle, 521 Monroe st., Chicago, Ill.

Pattern letters and figures to place on patterns for castings. H. W. Knight & Sons, Seneca Falls, N.Y.

For the latest improved Diamond Prospecting Drill, address the M. C. Bullock Mfg. Co., 138 Jackson st., Chicago, Ill.

Automatic Wire Straightening and Cutting Machinery, Tools, etc. Manufactured by Collins-Gibbons Mfg. Co., St. Louis, Mo.

Engine lathes, hand lathes, fine tools, files and supplies for machinists and other metal workers. Frasse & Co., 92 Park Row, N. Y.

Upright drills, improved, sizes 21", 23", 25", 28", 32", 36" swing; finely made and great capacity. Currier & Snyder, Worcester, Mass.

Most sensitive and durable Damper Regulator made; works within one pound; send for circular. T. Kieley, 11 W. 13th st., New York.

Curtis Pressure Regulators. Curtis Return Trap. Curtis Damper Regulator. See Feb. 14, p. 15. Send for circular No. 17. Curtis Reg. Co., Boston, Mass.

Fine tools and supplies for machinists and other metalworkers. Get our prices before purchasing elsewhere. Montgomery & Co., 105 Fulton st., N. Y. City.

W. H. Hoffman, consulting engineer, 108 Liberty st., room 3, N. Y. Mechanical engineering in all its branches, working drawings for the transmission of power by steam, water, air and electricity.

Contract work of all kinds executed promptly and on reasonable terms. Parties wishing grey iron castings in large quantities can make money by corresponding with Rawson Mfg. Co., Hornellsville, N. Y.

The Vance Lightning Flue Cutter is *the* tool for removing old flues from boilers and locomotives (will cut fifty an hour); sent on approval to railroad companies. Vance Tube Cutter Co., Geneva, N. Y.

A system of easy lettering, by J. H. Cromwell, giving 26 forms of alphabets. The space to be lettered being divided into squares; simple and effective. Price 50 cents. Catalogue of books for engineers free. E. & F. N. Spon, 12 Cortlandt st., N. Y.

Patterson, Jordan & Gottfried, 146-150 Centre st., N. Y. Metals, Machinery, Hardware, Tools and Supplies for Machinists, Mills, Engineers, Brass Goods Mfrs., Factories, etc. An extensive assortment of Bolts, Screws, Wire, Taps, Drills, etc., carried in stock.

Special facilities for the manufacturing of all kinds of light machinery, hardware and novelties, by contract or otherwise. Presswork and stamping done on short notice. Estimates furnished. Punches, dies and special tools made when required. Rockaway Mfg. Co., 3 E. 14th street, N. Y.

"Indicator Practice and Steam Engine Economy." By F. F. Hemenway. Contains plain directions for using the indicator, and making all required calculations from the diagram; also the principles of economy in operating steam engines and current practice in testing engines and boilers. Price $2, postpaid. Published by John Wiley & Sons, 15 Astor place, New York.

"Binders" for the AMERICAN MACHINIST. Two styles, the "Common Sense," as heretofore sold by us, and mailed to any address at $1.00 each, and the "New Handy," mailed at 50c. each. The former has stiff board covers, while the latter has flexible covers, with full page opening flat. Either will hold the entire 52 issues of any volume. AMERICAN MACHINIST PUB'G Co., 96 Fulton st., New York.

"Practical Drawing." By J. G. A. Meyer. The above series of articles, now running in the AMERICAN MACHINIST, should be closely followed by every student. They commenced with October 23, 1886 issue, and up to and including Feb. 14, 1889 issue, 70 articles have been so far published. Copies containing these articles sent by mail to any part of this country or Canada at 5 cents each. AMERICAN MACHINIST PUBLISHING Co., 96 Fulton st., New York.

"Modern Locomotive Construction." By J. G. A. Meyer. The above series of articles, now running in the AMERICAN MACHINIST, are attracting the attention of railway mechanics all over the world. Commencing with the June 27, 1885 issue, 84 articles have thus far appeared up to and including the Feb. 7, 1889 issue. Copies containing these articles sent by mail to any part of the U. S. or Canada at 5 cents each. AMERICAN MACHINIST PUBLISHING Co., 96 Fulton st., New York.

MANUFACTURES

The Cleveland (Tenn.) Chair Co. will rebuild its factory.

The Augusta (Ga.) Oil Mill Co. propose to build a larger mill.

N. Hill, Memphis, Tenn., is interested in building a cotton mill.

The Red River Lumber Co., Clay City, Ky., will build a new lumber mill.

The Linn Iron Works, Birmingham, Ala., propose to build a brass foundry.

The Sheffield Cotton Mill Co. propose to build a cotton mill at Sheffield, Ala.

The Chicago Steel Works, Chicago, Ill., have started their mill on double time.

The Cambria Iron Co., Johnstown, Pa., has arranged to roll 12-inch steel channels.

About $75,000 has been subscribed towards starting a yarn mill at Taunton, Mass.

The Norwich (N. Y.) Silk Manufacturing Co. will build a large addition to their mill.

The capital stock of the Troy (N. H.) Blanket Mills is to be increased to $80,000.

M. Ricks and others are forming a company to build a cotton mill at Mansfield, La.

The capital stock of the Windsor (Vt.) Machine Co. will be increased from $20,000 to $80,000.

A company with capital of $100,000 has been formed to build a cotton mill at Huntsville, Ala.

The Southern White Lead and Color Co., capital $50,000, will build a paint factory at Lynchburg, Va.

Plans have been made for the location of ten more saw mills along the Georgia Southern & Florida Railroad.

L. H. Hirshfield is interested in a stock company being formed to build a large woolen mill at Helena, Mont.

The D. Frisbie Company, 112 Liberty street, New York, inform us that they are very busy on friction pulleys, elevators, etc.

The National Fertilizer Co., of Nashville, Tenn., was recently burned out, at a loss of $75,000. The company will rebuild at once.

The new shoe factory to be built at Kennebunk, Me., for Kimball Bros., will be 150 feet long, 50 feet wide, and four stories in height.

G. W. Hutchinson is president of a company with a capital of $100,000 that will engage in the manufacture of a new stove at Kansas City, Mo.

Boynton & Plummer, Worcester, Mass., have issued a circular of their improved shaping machines, bolt cutters, drills, etc. The catalogue is well illustrated.

The Falls City (Ky.) Malleable Iron & Steel Co. are preparing to secure a site to build new and larger works within a year. They will probably start also malleable iron works.

Robert MacKinnon, Little Falls, N. Y., will erect a large mill to accommodate his increasing business of manufacturing knit underwear. It is to be a brick building, 123x60 feet, five stories high above the basement.

The Framingham Box Co. has organized at South Framingham, Mass., with Walter Adams president and W. M. Ranney treasurer, and a board of directors. Paper boxes will be the product of the company, which employs about 20 operatives to begin with.

There is water-works agitation at Cedartown, Ga.; Belleville, Kan.; Johnson City, Tenn.; Anniston, Ala.; Portland, Ore.; Vallejo, Cal.; Natchez, Miss.; Pulaski, Tenn.; Provincetown, Mass.; Tallahassee, Fla.; Medicine Lodge, Kan.; Cimmaron, Kan.; Letonia, Ohio.

The Blind River Mill Co., Limited (New Orleans, La.), capital stock, $50,000, has been chartered to operate saw-mills, manufacture staves, shingles, barrel-heads, etc. Alexander Muir is president; Edward S. Maunsell, vice-president, and James S. Leach, secretary and treasurer.

Henry R. Worthington, New York, has issued a special catalogue—the matter of which is copyrighted—illustrating and describing the Worthington Independent Condenser. The catalogue contains illustrations and descriptions of various uses of this condenser, and also other matter that will be found of interest to engineers.

A company has been organized at Delavan, Wis., with $15,000 capital stock, to be known as the Delavan Tack Company. The officers are as follows: S. L. Jackson, president and treasurer; J. H. Beadle, vice-president; M. D. Saggan, secretary. The old Delavan tack factory is to be utilized, and business will be commenced in a few days.

Poole & Hunt have dissolved partnership, after a business of over forty years. Mr. Hunt retires from the business, and will engage in something not so active. Mr. George Poole will take Mr. Hunt's place in the firm, and the firm will be under the name of Robert Poole & Son. Their shops are situated at Woodberry, a suburb of Baltimore.

The *Bonham* (Texas) *News* says: The best compress, the best broom factory, the best woodworks, the only tobacco factory, as good a mattress factory as can be found, and the best wagon and buggy factory in the State is just what Bonham can boast of, and twelve months hence she can boast of her long line of railway, of her cotton-seed oil mill, of her excellent water-works, of her fruit-canning factory, and her iron foundry. Only a little energy is necessary to have these additional advantages.

A press dispatch from Gainesville, Texas, says: There was a large and enthusiastic meeting at the court-house last night, composed of every class of citizens, in the interest of the proposed cotton factory. At the conclusion of the meeting the committee previously appointed reported that $38,000 had been subscribed, leaving a balance of $7,000. A canvass of the city was made to-day, and there is no doubt whatever that the required amount will be raised. A cotton factory for Gainesville is a certainty.

Messrs. J. T. Gallagher and John Vanderhook, of the Chicago Hardening, Tempering and Case-Hardening Co., are prepared to receive orders for all kinds of hardening, tempering and straightening, as well as annealing without scaling. They also solicit orders for the hardening of taps, dies, reamers, drills, milling cutters and metal saws, lathe and planer tools, etc. Among the things for which their skill and experience are eminently fitted, and for which their factory offers great facilities, are the following: Drills hardened to drill hard steel; chrome or other steel hardened for burglar-proof work; large cutters and other tools for heavy work hardened and tempered without cracking; case-hardening of iron or steel done to any depth; malleable and mild steel converted into steel that will stand hammering and hardening. Their business, they say, is good, and they are full of local work. Their place of business is at No. 51 West Washington street.—*Industrial World.*

Harry Comstock has withdrawn from the Syracuse Forging and Gun Co.—which recently removed its works to Batavia, N. Y.—and has formed a company to build a factory at Fulton, N. Y., for making guns of his own invention. The Fulton *Patriot and Gazette* says: The contracts for the necessary buildings are to be let within a week. The main building is to be of brick, with a 16-inch wall, 220 feet long, 50 feet wide, and four 12 feet stories high, with the necessary outbuildings for blacksmithing, brazing, case-hardening, soldering and bluing. This smaller building will be a one-story structure, 60 feet long by 24 feet wide, with the latest improved furnaces for the work required of them. Their water-power is the finest in this country, having the whole Oswego river, a never-failing stream, to supply their power. . . . Altogether, when completed, this structure, fully equipped with the finest machinery, will cost not far from one hundred thousand dollars, and the capital of the company will be $250,000. It will afford employment for from two to three hundred operatives.

Machinists' Supplies and Iron.

NEW YORK, Feb. 23, 1889.

Iron—American Pig.—The character of the demand remains substantially the same as at our last report, and is confined to the current needs of consumers. There seems to be a feeling of hope for the future, however, though there is no improvement in demand. We quote No. 1 X Foundry, $17 to $18; No. 2 X, $16 to $17, and Grey Forge, $15 to $15.50.

✲WANTED✲

"Situation and Help" Advertisements only inserted under this head. Rate 30 cents a line for each insertion. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue.

Wanted—See bottom of third column, page 11.

Draftsman of 15 years' experience, steam engines and general mach. wants position. W. 7., AM. MACH.

Wanted—Experienced steam pump salesman. Address Edward, care AMERICAN MACHINIST.

Wanted—An educated and experienced draftsman. Davies & Thomas, Catasauqua, Lehigh Co., Pa.

Good mech. draftsman, graduate, some experience, wants position on engine and boiler work. Address BOX 65, AMERICAN MACHINIST.

Mechanical draftsman wanted. None but experienced men need address, stating experience, R. Hoe & Co., 504 Grand st., New York.

Wanted—A good draftsman familiar with steam engine work. Please apply by letter, stating age, experience and terms, to Box 108, Providence, R. I.

A young man, age 25, wants situation as mech. draftsman; is a tech. school graduate and machinist; has extensive designing exp. W. C., AM. MACHINIST.

Situation wanted by a technical school graduate with experience as machinist and draftsman; intelligent and energetic. P., AMERICAN MACHINIST.

Graduate tech. college wishes position as draftsman or assist. supt.; specialty, high-speed engines; first-class ref. West preferred. Box 69, AM. MACH.

Wanted—Mechanical draftsman on printing machinery. Address, stating age, exp., refs., and pay required, Golding & Co., Fort Hill sq., Boston, Mass.

Wanted—Position as superintendent or foreman, by thoroughly practical machinist and draftsman; understands handling men to best adv. Light automatic mach. preferred. References, AM. MACHINIST.

Wanted—Two temperate first-class green-sand non union iron moulders; steady work and good wages given. Address D. P. Briggs, 394 Kennard st., Cleveland, Ohio.

Competent designer and draftsman open to engagement; extended practical shop exp., mach. tools and mfg. mach. a specialty; versed in details of shop management. Ref. present employers; responsible and permanent situation preferred. "C.," AM. MACH.

Wanted—An experienced and highly skilled mechanical engineer; one qualified to construct fine mach.; only a first-class man need apply. Liberal salary and permanency assured to right man. Give refs. and full particulars as to line of work in which heretofore engaged. The Lanston Type Machine Co., Room 104, Atlantic Bldg., Washington, D. C.

Wanted—Foreman machinist for small shop making a specialty of sheet-metal working machinery and tools, but also building small machinery in general; a man who can mix brains with the supervision of such work so as to make a business inherently profitable pay; must be able to work from drawings, be familiar with milling and special tools, and have had a fair experience handling men. Applicants willing to submit to a close inquiry into their antecedents in proof of above requirements, please address with references, "In Haste," AM. MACHINIST.

✢ MISCELLANEOUS WANTS ✢

Advertisements will be inserted under this head at 15 cents per line, each insertion.

Gerlach's Engineers' specialties beat the world. Send for price list. Crescent Mfg. Co., Cleveland, O.

Crescent grease cup for shafting beats them all. Sample free. Crescent Mfg. Co., Cleveland, Ohio.

Machinists.—Increase your income without capital or risk. See page 14, column 1.

Punches, Dies and special machinery built to order. C. F. Langston & Co., 70 N. 4th st., Phila., Pa.

Light and fine machinery to order; Foot Lathe. Catalogue for stamp. E. O. Chase, Newark, N. J.

August C. Christensen, 24 State St., N. Y., consulting engineer for hydr. and pumping machinery, etc.

The patent on scale for measuring pipe and fittings, as shown in AMERICAN MACHINIST, Jan. 24, is for sale. W. L. Cheney, Hartford, Conn.

Roper's Engineer's Handy-book, the best book ever published for Engineers. Post free, $3.50. Send for list. Thos. Ordish, 1723 S. 7th st., Phila., Pa.

For Sale—Patent and tools for making an improved combination square bevel protractor, etc. H. W. Merrill, 135 Oliver st., Boston, Mass.

How to remove and prevent scale in steam boilers at a cost of ten cents a week. Send postal for circular to Pittsburgh Boiler Scale Resolvent Co., Pittsburgh, Pa.

Wanted—To buy second-hand lathes, planers and shapers of all sizes; must be cheap and in good order. Fosdick & Plucker, 6th and Culvert Streets, Cincinnati, O.

The owners of Patents for the manufacture of improved Cast-iron Pulleys by a method that reduces the cost 40% below present processes propose to license a few parties to manufacture. Correspondence solicited. Address "Pulley," AM. MACHINIST.

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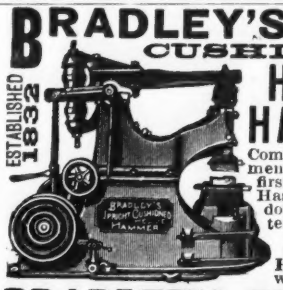

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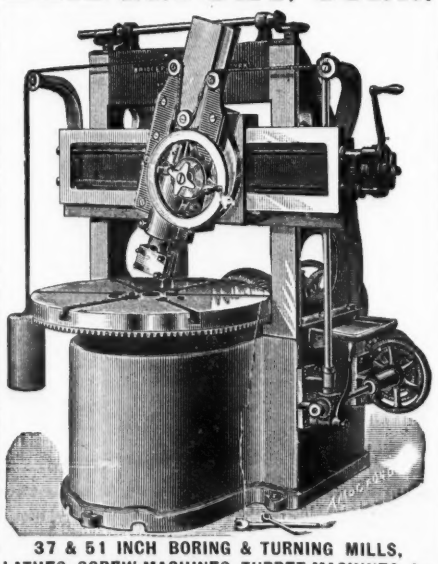

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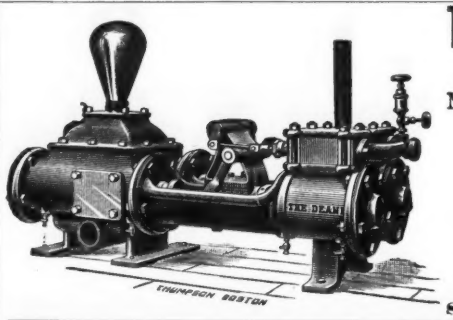

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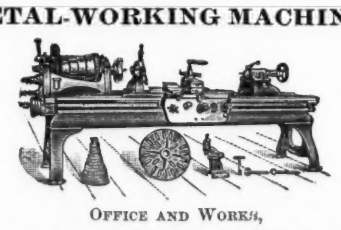

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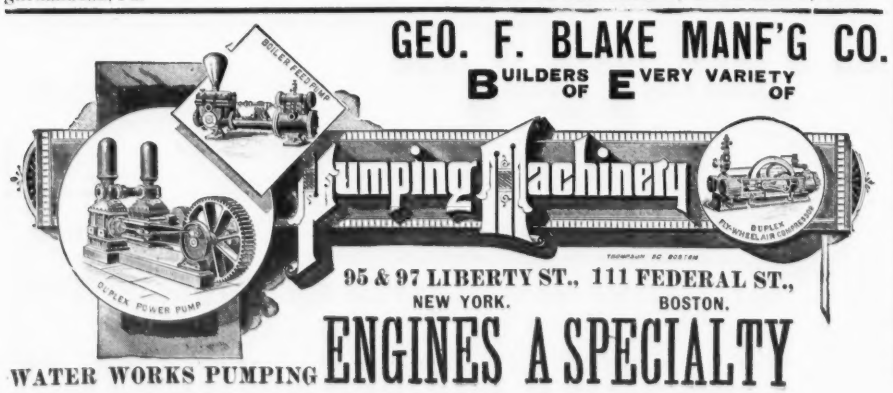

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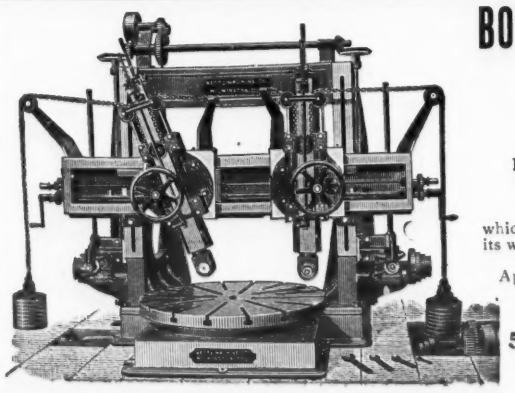

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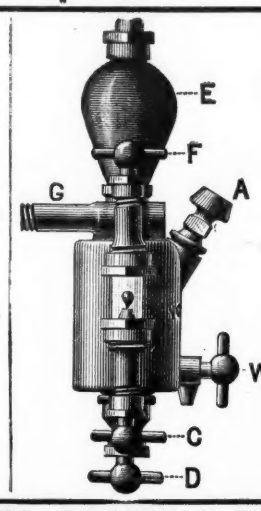

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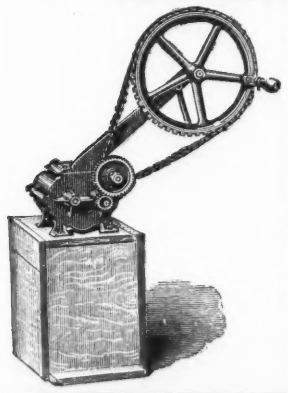

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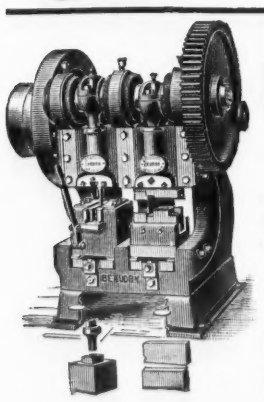

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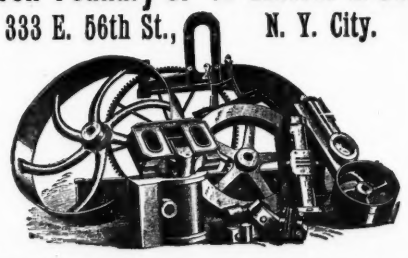

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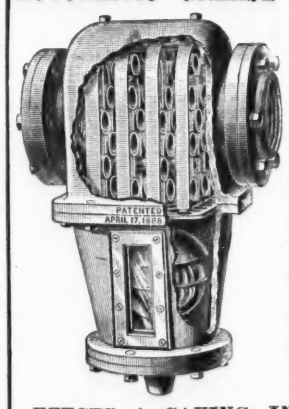

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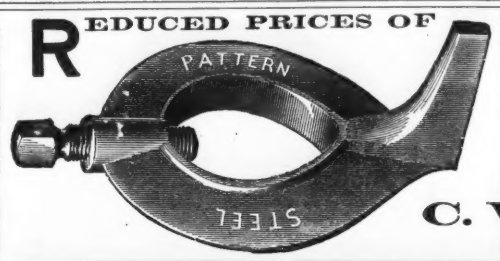

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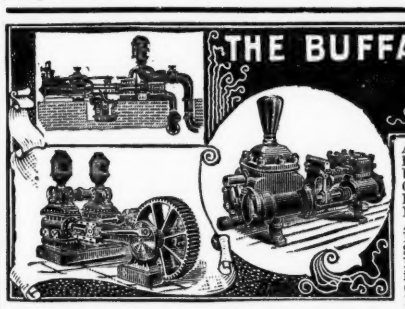

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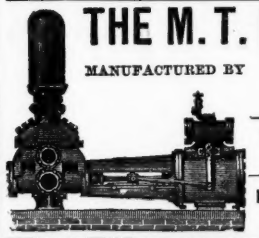

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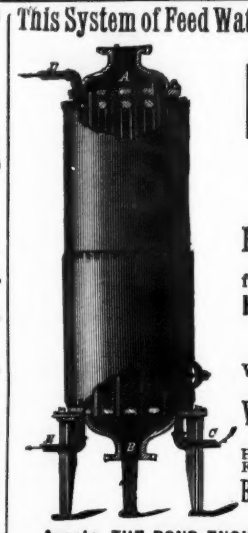

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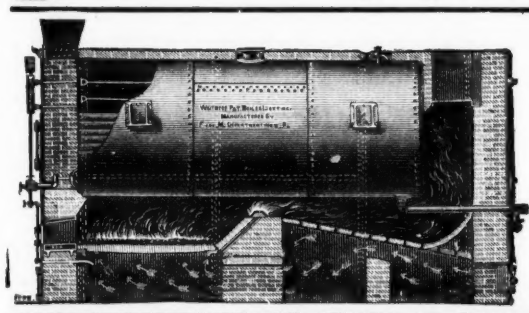

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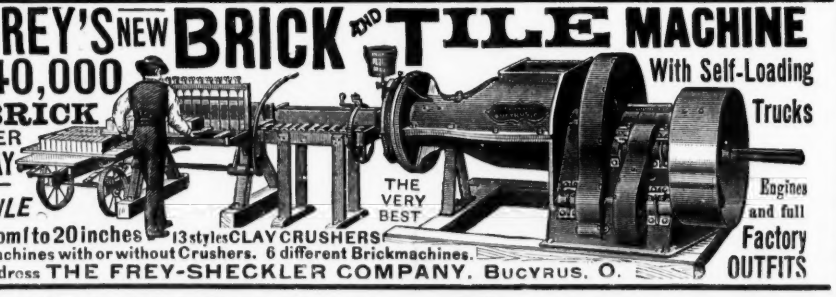

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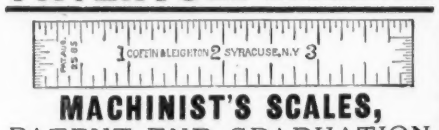

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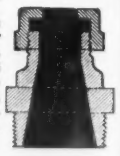

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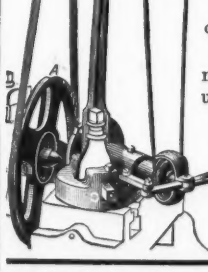

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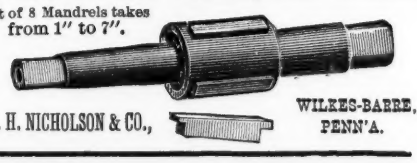

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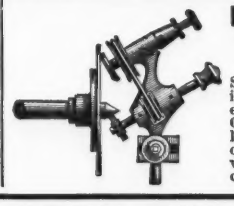

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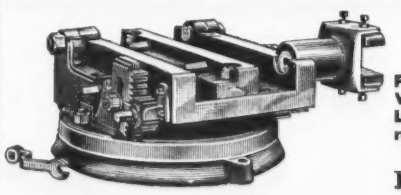

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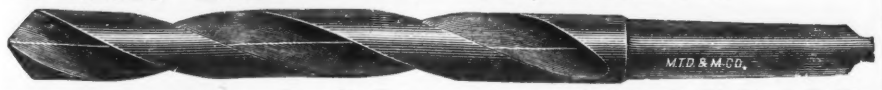

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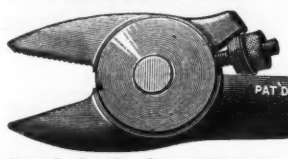

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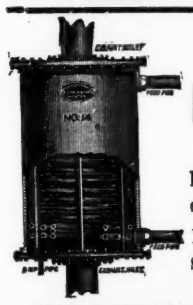

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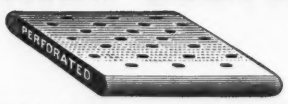

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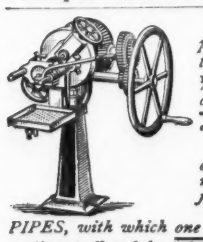

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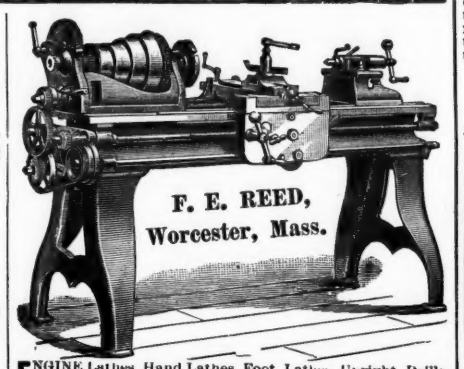

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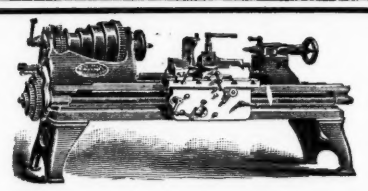

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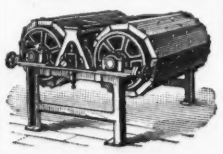

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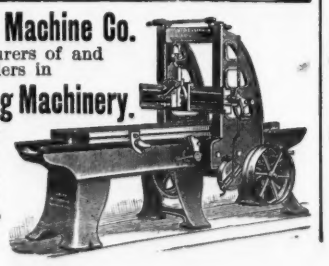

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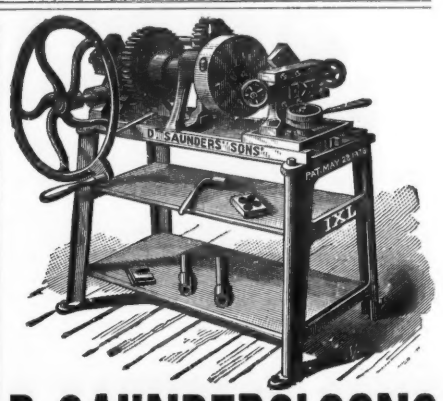

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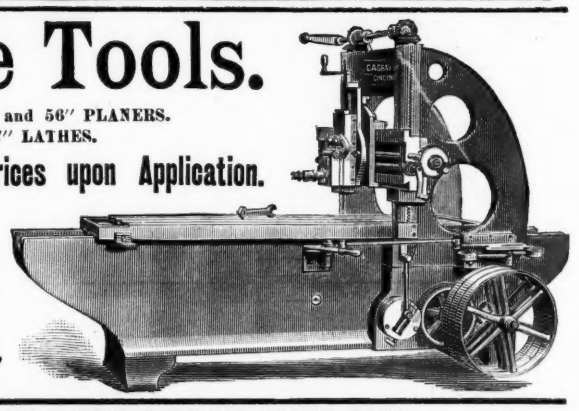

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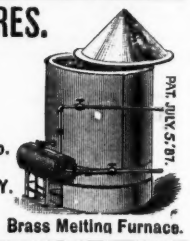

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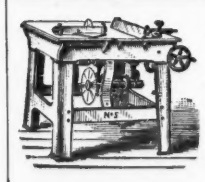

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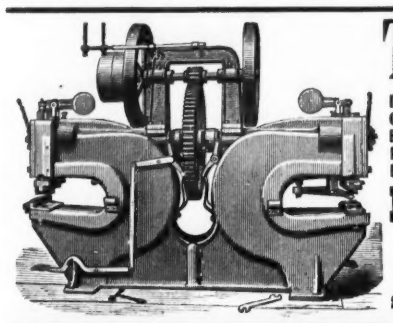
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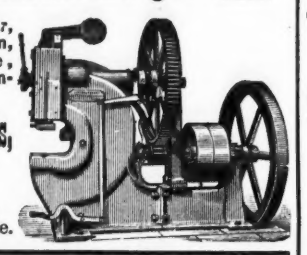

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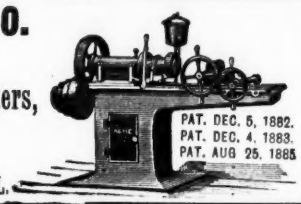
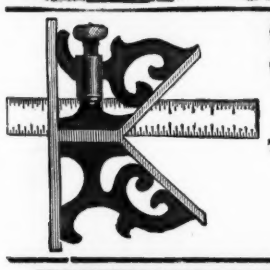

PAT. DEC. 5, 1882.
PAT. DEC. 4, 1883.
PAT. AUG 25, 1885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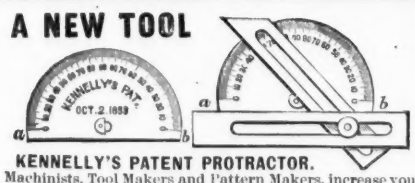
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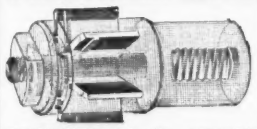
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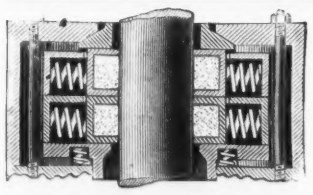
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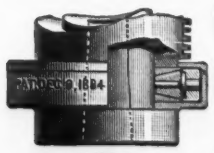
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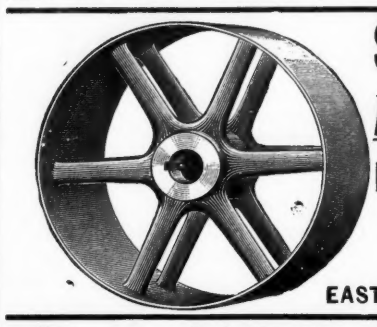
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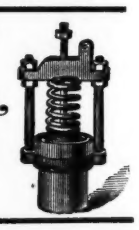

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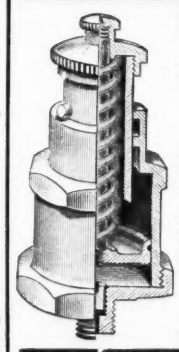
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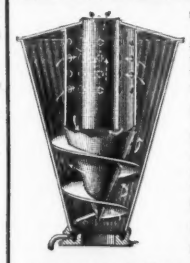
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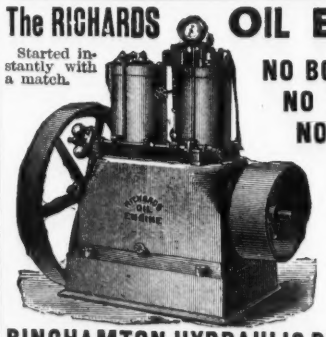
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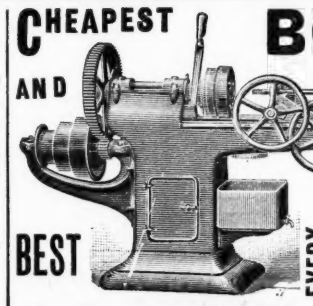
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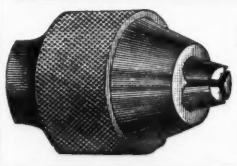
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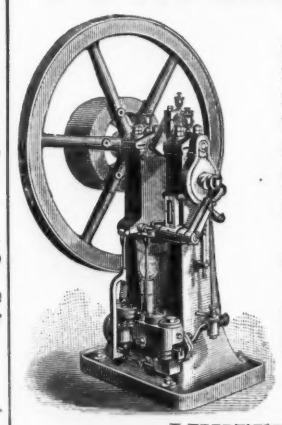
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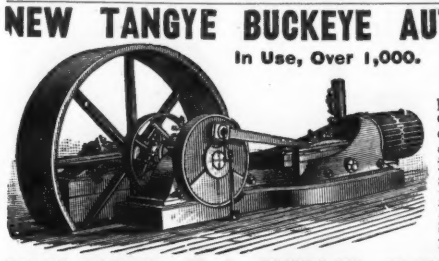

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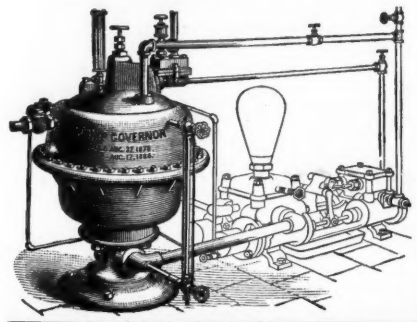

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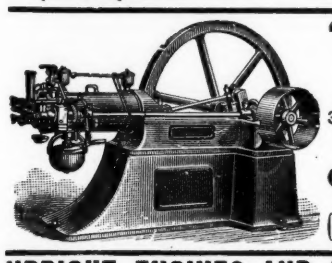

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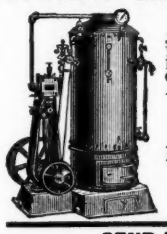

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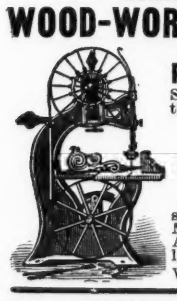

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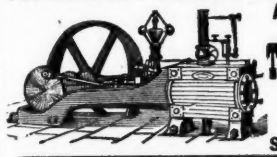

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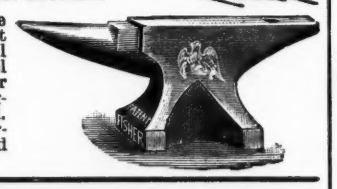

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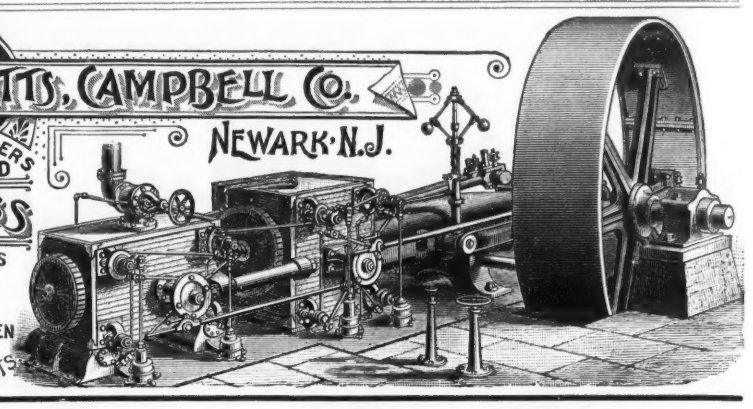

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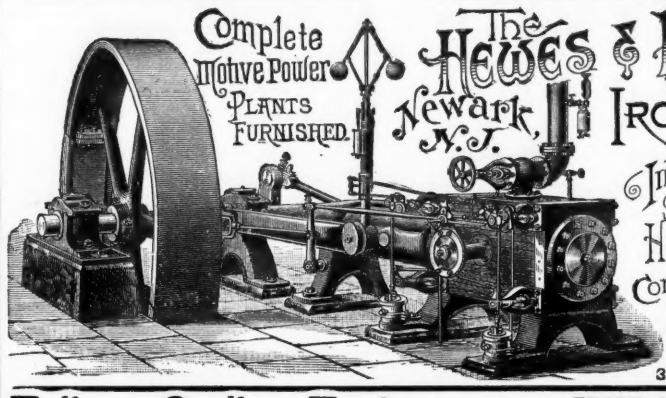

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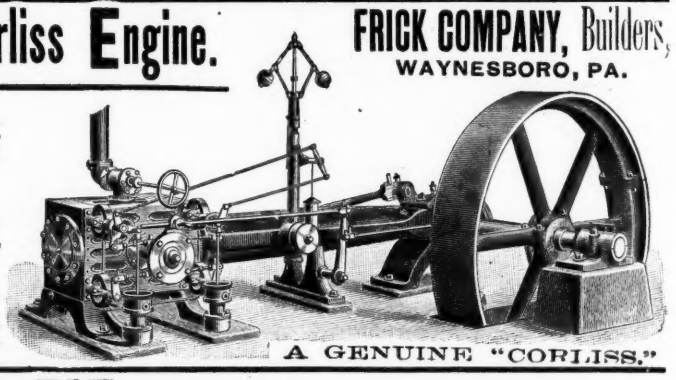

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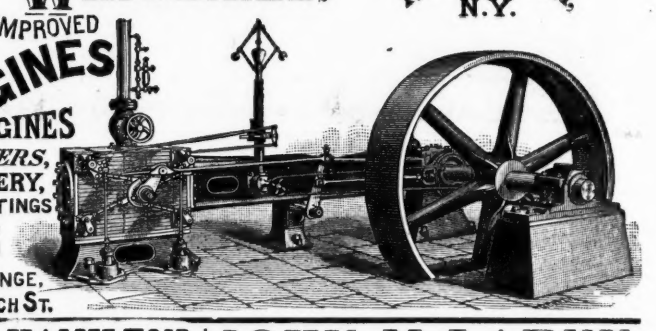

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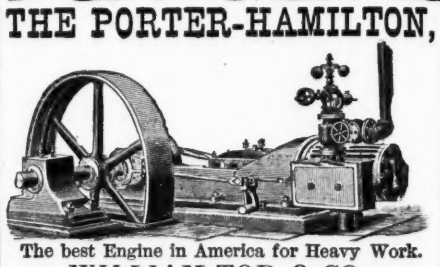

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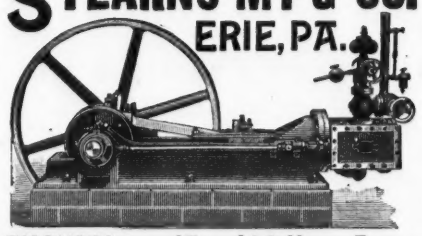

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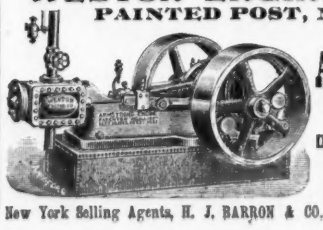

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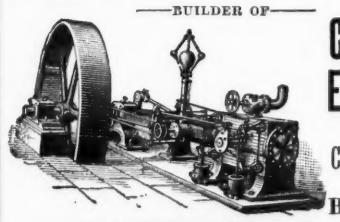


CORLISS Engines, AIR Compressors and BOILERS.

HOBOKEN, N. J.

List of Second-Hand MACHINERY

TAKEN IN TRADE FOR NEW.

10" x 5' Engine Lathe,	F. E. Reed.
12" x 5' Engine Lathe,	Prentice, (new).
15" x 6' Engine Lathe,	Lathe & Morse.
16" x 6' Engine Lathe.	Powell.
16" x 6' Engine Lathe,	Blaisdell.
16" x 11' Engine Lathe,	New Haven.
20" x 8' Engine Lathe,	Powell.
21" x 10' Engine Lathe,	Lathe & Morse, (new).
36" x 10' Engine Lathe,	Putnam Machine Co.
Cabinet Turret Lathe,	Lodge, Davis & Co. (new).
16 "x16" x 3' Planer,	Lathe & Morse.
24" x 24" x 6' Planer,	Chamberlin.
26" x 26" x 6' Planer,	Hendey.
30" x 30" x 8' Planer,	Bement.
36 "x 36 "x 10' Planer,	Whitcomb, (new).
42" x 42" x 10' Planer,	William Gleason.
15" Stroke Shaper,	Hendey.
20" Upright Drill,	Prentice.
22" Upright Drill,	Reed.

Above 2d-hand tools are in first-class condition. Write for list giving prices and descriptions.

We also carry much the largest stock of New Machine Tools in the country.

HILL, CLARKE & CO.

156 OLIVER STREET, BOSTON, MASS.

NO. 3 UNIVERSAL CUTTER & REAMER GRINDER.

MADE BY BROWN & SHARPE MFG. CO., PROVIDENCE, R. I.

SEND FOR SPECIAL PAMPHLET.

TESTIMONIALS.

Cooke Locomotive and Machine Co.

BROWN & SHARPE MFG. CO., Providence, R. I. PATERSON, N. J., June 12, 1888.

Gentlemen:—Replying to your favor of May 16th, we are very much pleased with the No. 3 Universal Cutter and Reamer Grinder purchased from your Company. It does its work well and gives good satisfaction.

Yours truly, JOHN S. COOKE, *President*.

Poole & Hunt, Founders and Machinists.

BROWN & SHARPE MFG. CO., Providence, R. I. BALTIMORE, MD., May 14, 1888.

Gentlemen:—We have had one of your No. 3 Universal Cutter and Reamer Grinders in use in our establishment for nearly five years, and find it a very useful and efficient machine. We consider it a very important part of the outfit of a well-equipped machine shop. We are, Yours truly, POOLE & HUNT.

The Mergenthaler Printing Co.

BROWN & SHARPE MFG. CO., Providence, R. I. BALTIMORE, MD., May 18, 1888.

Gentlemen:—We have had one of your No. 3 Universal Cutter and Reamer Grinders in use in our works since February, 1887, and find it a very useful and valuable addition to the list of modern improved tools for machinists' use. Its simplicity, wide range of adaptation and economy of time in use, commend it very strongly to progressive men in our line of business.

Yours truly, THE MERGENTHALER PRINTING CO.

Whitely, Fassler & Kelly, Proprietors Champion Harvesting Machine Works.

BROWN & SHARPE MFG. CO., Providence, R. I. SPRINGFIELD, OHIO, U. S. A., June 1, 1888.

Gentlemen:—We have used one of your No. 3 Universal Cutter and Reamer Grinders in our factory for quite a while, and we wish to say to you that it is a splendid tool. Its work is entirely satisfactory to us, and we consider it an indispensable tool and could not well do without it, and we cheerfully recommend it to the public. Yours truly,

JAMES A. DICUS, *Superintendent*.

The Warder, Bushnell & Glessner Co.

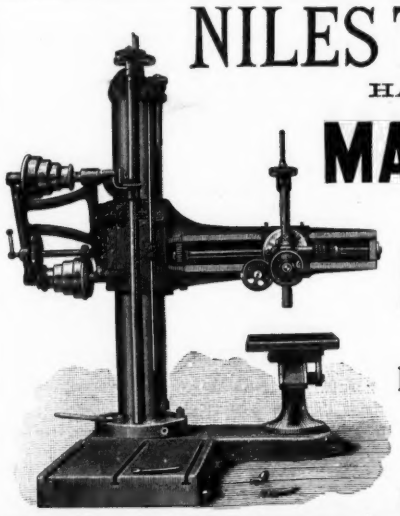
BROWN & SHARPE MFG. CO., Providence, R. I. SPRINGFIELD, OHIO, May 18, 1888.

Gentlemen:—Replying to your favor of the 16th inst., would say that the No. 3 Universal Cutter and Reamer Grinder we purchased from you nearly four years ago is giving us the very best of satisfaction. We have a number of different tool grinding machines for Cutters, Mills, etc., but your No. 3 Cutter and Reamer Grinder is the most conveniently arranged, and is applicable for grinding all kinds and styles of milling cutters. We have not yet found a cutter that this machine could not grind and make a perfect job of it. Yours truly, THE WARDER, BUSHNELL & GLESSNER CO.

WESTERN AGENT, S. A. SMITH, 23 So. CANAL ST., CHICAGO, ILL.

NILES TOOL WORKS,

HAMILTON, OHIO.



MACHINE TOOLS.

UNIVERSAL

Radial Drilling Machines.

NEW PATTERNS, 1887.

Increased Power. Great Strength. Arm Rotates Freely. Quickly Handled. Drill-Head Balanced.

Patented May 10, 1887.

CRANES

THE YALE & TOWNE MFG CO.,
STAMFORD CONN
NEW YORK. CHICAGO. PHILA. BOSTON

The Original Unvulcanized Packing

CALLED THE STANDARD—As it is the Packing by which all others are compared.

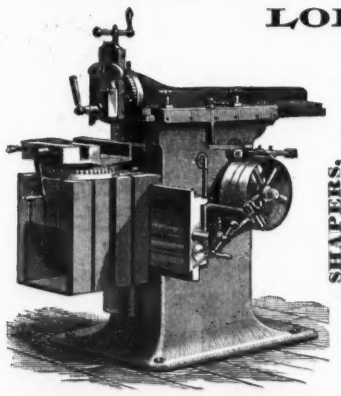
Accept no packing as JENKINS PACKING unless stamped with our "Trade Mark."

JENKINS BROS. { 71 JOHN STREET, N. Y. / 105 MILK STREET, BOSTON. / 21 NORTH FIFTH ST., PHILA. / 54 DEARBORN STREET, CHICAGO.

SHAPERS, ENGINE LATHES AND DRILLS.

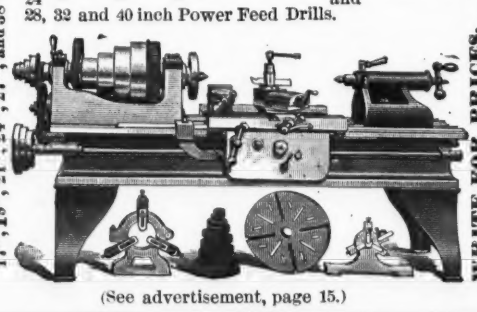
LODGE, DAVIS & CO.,

CINCINNATI, OHIO.



SHAPERS, 15" and 20" Crank, 20", 26", 32" Geared.
ENGINE LATHES, 17", 19", 21", 24", 27", and 38".

20 inch Upright Drills. 25 inch Back Geared, and
24 " " " 28, 32 and 40 inch Power Feed Drills.



WRITE FOR PRICES. IT WILL PAY YOU.

(See advertisement, page 15.)

GOULD & EBERHARDT,

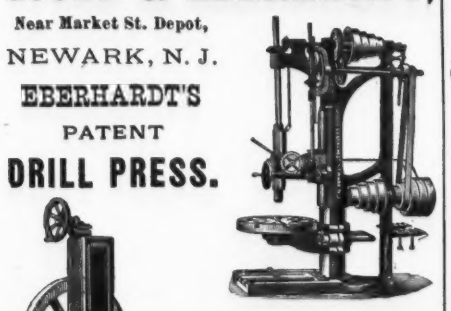
Near Market St. Depot,

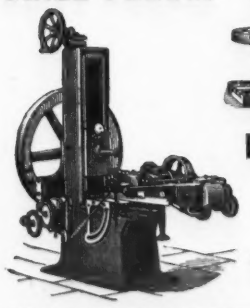
NEWARK, N. J.

EBERHARDT'S

PATENT

DRILL PRESS.





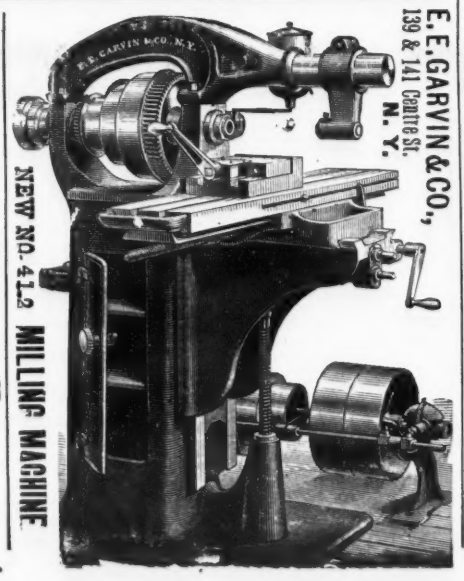
EBERHARDT'S

Patent

GEAR CUTTER.

Sizes, 18", 25", 36", 50", 60", 84".

GEAR AND RACK CUTTING TO ORDER.



E. E. GARVIN & CO., 139 & 141 Centre St. N. Y.

NEW NO. 412 MILLING MACHINE

THE PRATT & WHITNEY COMPANY,

Hartford, Conn.

MANUFACTURE

PLANERS

To plane 16 in. x 16 in. x 3 ft., to 60 in. x 60 in. x 20 ft., with quick return motion.

PILLAR + SHAPERS

With 6 in. x 10 in. stroke.

SHAPING MACHINES

With 12 in. and 14 in. stroke, all feeds automatic.

PRICE LIST —AND— Discount Sheet SENT UPON APPLICATION.

WESTERN BRANCH: 100 West Washington St., Chicago, Ills.

THE BILLINGS AND SPENCER CO., HARTFORD, CT., U. S. A.

MANUFACTURERS OF

BILLINGS' DOUBLE-ACTING

RATCHET DRILL,

For Morse Taper Shank Drills.

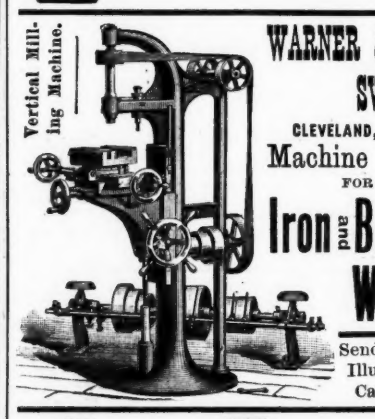
Packer Ratchet Drills,

Packer Boiler Ratchet Drills,

Packer Auger Ratchet Drills,

DROP FORGINGS

OF EVERY DESCRIPTION.

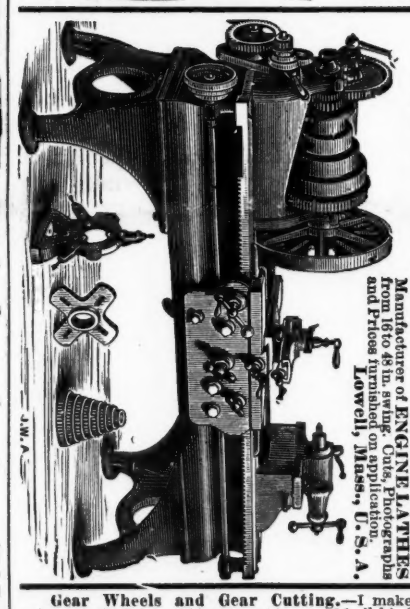


WARNER & SWASEY,

CLEVELAND, OHIO.

Machine Tools FOR Iron and Brass Work.

Send for Illustrated Catalogue.

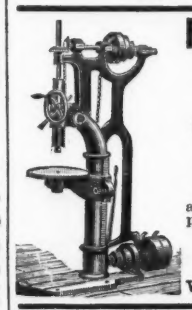


GEO. W. FIFIELD,

Manufacturer of ENGINE LATHES from 16 to 48 in. swing. Cuts, Photographs and Prices furnished on application.

Lowell, Mass., U. S. A.

Gear Wheels and Gear Cutting.—I make g to order, or cut teeth on g blanks sent to me. Of all kinds. Of all sizes to six ft. dm. Small orders or large ones. Fine g or cheap g. Small cast g. Ready made brass g by mail at low prices. Bevel g with perfect planed teeth. Hand Book on g, $1. Facilities complete. Terms reasonable. Send for cat. GEO. B. GRANT, 66 Beverly St., Boston, Mass.



Key-Seating Machines and 20 in. Drills

A SPECIALTY.

SEND FOR LIST OF

New and Second-Hand

Lathes, Planers, Drills, or anything in Machinists' Tools or Supplies.

W. P. DAVIS,

Rochester, N. Y.

Works at North Bloomfield.

REMOVAL.

THE POND MACHINE TOOL COMPANY,

Formerly of Worcester, Mass.

The new shops of this company are located at Plainfield, N. J., forty minutes' ride from New York city on the line of the Central Railroad of N. J., and consist of the following:

A machine shop 500′ long by 100′ wide; a foundry 250′ long by 90′ wide; also commodious buildings for the storage of sand, coal, coke and pig iron; ample and convenient wash rooms for the men; fireproof two story pattern storage; blacksmith shop; engine and boiler houses. These buildings are detached from the machine shop and foundry. There is an elevated railroad for the convenient distribution of raw materials, and a railroad running through the machine shop for shipping. The whole plant is supplied with the incandescent system of electric lighting.

The machine shop and foundry have overhead traveling cranes running through their entire lengths; also light traveling cranes, which serve every tool, and a number of jib cranes in the foundry and scratch rooms. The foundry has capacity for making the heaviest class of castings.

All our tools are expressly designed for the economical manufacture of heavy machinery for railroad and general machine shop equipment, from new patterns of the latest and best designs.

SALESROOM and OFFICE, 111 & 113 Liberty St., N. Y. City.
NEW SHOPS, Plainfield, N. J.

HARTFORD STEAM BOILER INSPECTION AND INSURANCE CO.
HARTFORD, CONN.

J. M. ALLEN, PRESIDENT.
WM. B. FRANKLIN, VICE-PRESIDENT.
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PATENT UNIVERSAL SCREW-CUTTING CENTER DEPTH ANGLE AND
J. WYKE & CO., TWIST DRILL GAUGE.
Fine Machinists' Tools.—E. Boston, Mass.—Send for Circular

NEW CATALOGUE

MACHINE TOOLS.

THE G. A. GRAY CO.,

477-481 SYCAMORE ST., CINCINNATI, O.

See advertisement, page 13.

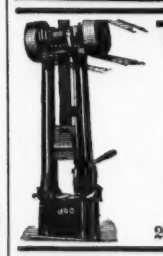
STEEL CASTINGS.

PRATT & LETCHWORTH,

PROPRIETORS

BUFFALO STEEL FOUNDRY,

BUFFALO, N. Y.



The STILES PATENT DROP HAMMER,

Manufactured by

THE STILES & PARKER PRESS CO.,

MIDDLETOWN, CONN.

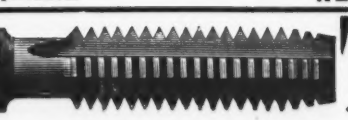
ALSO MAKERS OF

PUNCHING STAMPING DRAWING **PRESSES** and DIES.

Branch Office and Factory, 203, 205 & 207 CENTRE ST., NEW YORK CITY.

200 p. Catalogue on application.

J. M. CARPENTER
PAWTUCKET, R. I.



Manufacturer —of— **TAPS & DIES**